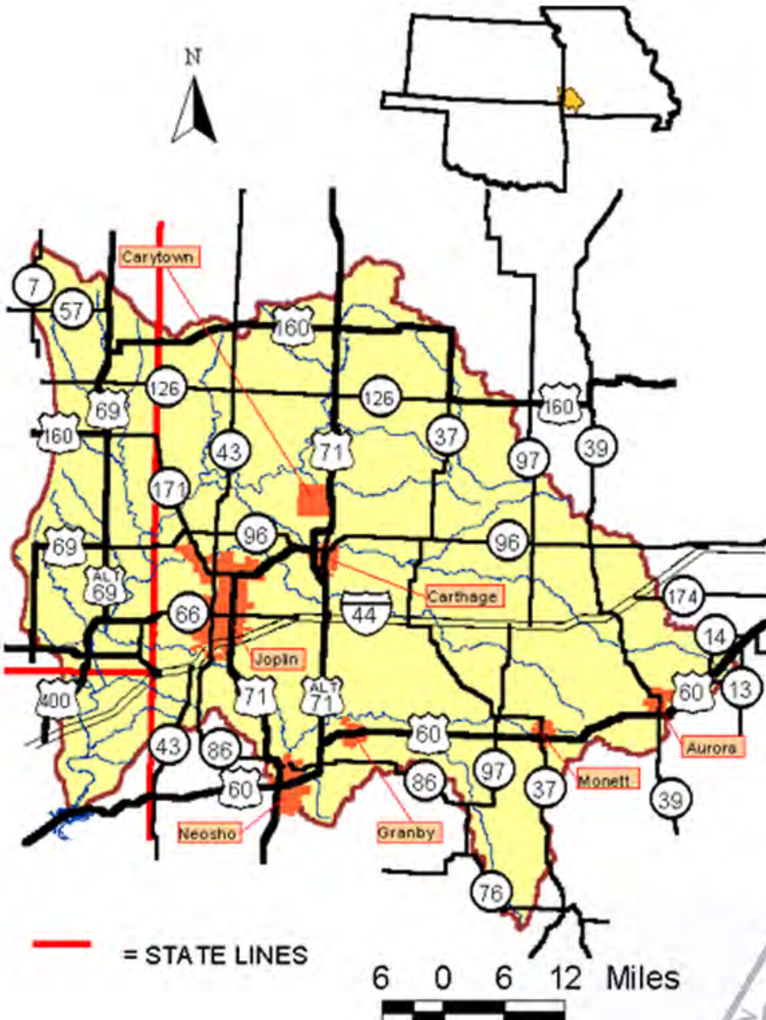

Spring River Watershed

Watershed and Inventory Assessment, Date

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Acknowledgements

Early efforts by Kay Goddard and John Goddard were instrumental in the preparation of this document. Tim Banek and Stan Sechler collected fish samples and completed SHAD surveys throughout the basin. Dr. William Pflieger assisted with the identification of fish samples. A number of temporary employees, too numerous to list here, also contributed to the completion of this document.

Executive Summary

The Spring River Basin is located in southwest Missouri in Barry, Barton, Christian, Dade, Jasper, Lawrence, Newton, and Stone counties. The basin lies along the border between the Osage Plains and Springfield Plateau physiographic regions. The Spring River originates along the Barry-Lawrence county line south of Verona, flows west-northeast to its confluence with the North Fork of the Spring River east of Asbury in Jasper County and then southwest into Kansas and grand lake of the Cherokees in Oklahoma. Major tributaries within the basin are the North Fork of the Spring River, Center Creek, Turkey Creek, and Shoal Creek. Numerous smaller tributaries flow throughout the basin.

The Spring River Basin is essentially rural, and land use varies across the basin as a reflection of the transitional nature of its topography and relief. Forest lands are scattered; many are located along stream drainages. Mining has been an important part of the area's economy since the 1850s. Land use in the North Fork of the Spring River portion of the basin is approximately 85% agricultural (pasture and roe cropping) and 15% forested. Land use in the Spring River portion of the basin is estimated at 70% rowcrop and pasture and 30% forested. In the Center/Shoal Creek sub-basin, land use is approximately 52% rowcrop and pasture, 45% forest cover, and 3% mined lands. Major cities and towns in the basin include Joplin, Neosho, Carthage, Mount Vernon, Monett, Lamar, Sarcoxie, Aurora, and Webb City.

The Spring River watershed totals 2, 271 square miles. Streams of order 5 or greater are Spring River, Center Creek, North Fork of the Spring River, Shoal Creek, Clear Creek, Dry fork, Jones Creek, Little North Fork of the Spring River, Pettis Creek, and Williams Creek. The total mileage of streams with permanent flow is 331 miles. Intermittent streams with permanent flow another 188 miles. Several losing stream reaches and numerous springs are also located in the basin.

Point source pollution affects many of the streams in the basin. Effluent from sewage treatment facilities enter streams at several locations. Numerous industries, mines, subdivisions, mobile home parks, and the Neosho Fish Hatchery all have permits to discharge treated wastes into streams.

Potential source of nonpoint source pollution in the basin include: runoff from mine tailing and active mining sites, dairy operations, poultry husbandry, sedimentation from erosion in disturbed watersheds, sludge application from sewage treatment facilities, seepage from septic tanks, and runoff from urban areas. A health advisory, recommending against the consumption of fish from the Spring river from Verona to Hoberg because of dioxin contamination from runoff at manufacturing plant, was issued during the late 1980's, but was lifted in 1993. There are currently no advisories listed for the basin.

The Spring River Basin encompasses two major aquatic community divisions, the Ozark-Neosho and the Prairie-Neosho. The Ozark-Neosho Division includes the entire basin except the northern tributaries of the Spring River from (and including) the North Fork of the Spring River to the Kansas state line. The Prairie-Neosho Division includes the Little North Fork and North Fork of the Spring River drainages, excluding Buck Branch and lower Dry Fork.

Eighty-six fish species and thirty-five mussel species have been collected in the basin. Common sportfish include smallmouth bass, largemouth bass, spotted bass, whit crappie, rock bass, channel catfish, and rainbow trout. There are several state or federally listed threatened and endangered species, including the Ozark cavefish, Neosho madtom, redfin darter, Arkansas darter, western fanshell, Neosho mucket, bluntface shiner, and western slim minnow.

Stream habitat quality is fair too good throughout most of the basin. Some areas, including portions of the Capps Creek subbasin, suffer from a severe lack of riparian vegetation. The lack of adequate riparian corridors, effects of runoff from mined areas, excessive nutrient loading, streambank erosion, excessive runoff and erosion, and the effects of in stream activities such as gravel mining are among the problems observed in the basin. Grazing practices along many streams contribute to streambank instability, nutrient loading, and poor riparian conditions. Increased timber clearing and higher runoff associated with

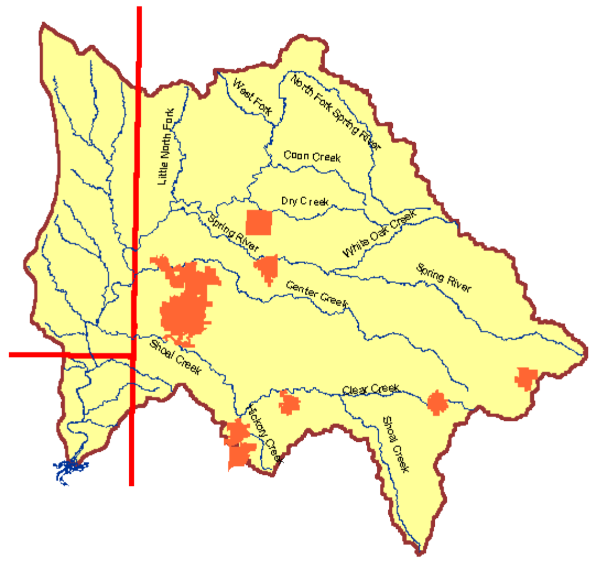
urbanization in the basin also impact stream habitat quality.

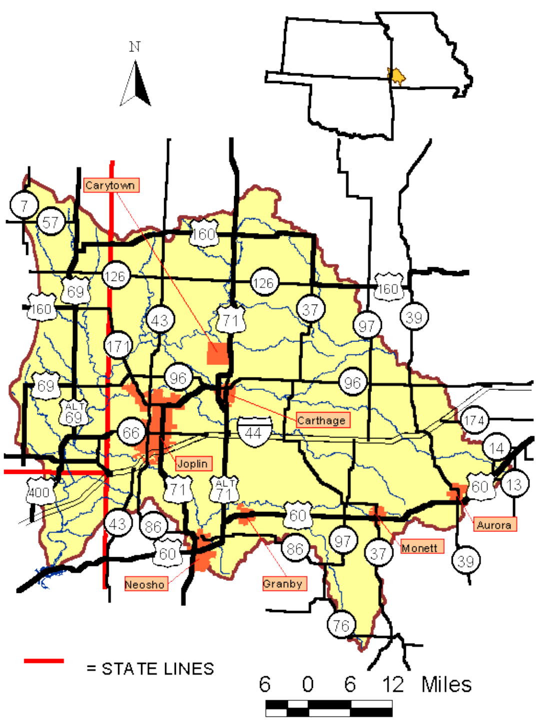
Our major goals for the basin are improved water quality, better riparian and aquatic habitat conditions, the maintenance of diverse and abundant populations of native aquatic organisms and sportfish, increased recreational use, and increased public appreciation for the stream resources. Additional fish population samples will be collected and appropriate habitat surveys will be conducted. Fishing regulations will be revised, as needed, and limited stocking will be used to maintain and improve sportfishing. Access will be improved, where needed. Cooperative efforts with other resource agencies on water quality and quantity, habitat, and watershed management issues will be critical. Enforcement of existing water quality and other stream related regulations and necessary revisions and additions to these regulations will help reduce violations and lead to further promote public awareness and incentive programs and cooperating with citizen groups and landowners will result in improved watershed conditions and better stream quality.

Location

The Spring River Basin is located in southwest Missouri in Barry, Barton, Christian, Dade, Jasper, Lawrence, Newton, and Stone counties. The Spring River originates along the Lawrence-Barry county line south of Verona (Figure 1), flows west-northwest to its confluence with the North Fork of the Spring River east of Asbury in Jasper County and then southwest into Kansas and Grand Lake of the Cherokees in Oklahoma. Major tributaries within the basin are the North Fork of the Spring River, Center Creek, Turkey Creek, and Shoal Creek. Numerous smaller tributaries flow throughout the basin (Figure 1).

Figure 1. Location of the Spring River watershed.





Geology

Physiographic Regions

The Spring River Basin is located along the border between the Osage Plains and the Springfield Plateau (MDNR 1986).

The Osage Plains are a subdivision of the Central Lowland Physiographic Region and encompass the northwest portion of the Spring River Basin. This is an unglaciated area of smooth to rolling plains with low relief formed on Pennsylvanian sedimentary rock (MDNR 1986).

The Springfield Plateau forms the western-most member of the three subdivisions of the Ozark Plateau and encompasses most of the Spring River Basin. Elevations range from 1, 000 to 1, 700 feet above mean sea level (msl). Mississippian limestones underlay the region, and karst features are locally prominent.

Geology

The southern and eastern portions of the Spring River Basin, including the eastern and southern portions of the North Fork of the Spring River watershed and the Turkey Creek, Shoal Creek, and Center Creek watersheds, have surface layers comprised primarily of Mississippian age limestones (MDNR 1984). A few remnants of Pennsylvanian sandstones and shales are dispersed throughout this area. A substantial portion of this area lies in the Burlington-Keokuk limestone within which most springs in the area are formed. Springs are relatively common, but generally low yielding (Table 1, Figures 2A-F). Base flows are well sustained during dry periods.

The northwest portion of the basin, which makes up the western portion of the North Fork of the Spring River watershed, lies within deposits of shale, sandstone, siltstone, limestone, clay, and coal of Pennsylvanian age (MDNR 1984). Springs are poorly developed, infiltration to subsurface strata is limited, and base flows are poorly sustained during dry periods.

Soil Types

Three major soil regions are represented within the Spring River Basin; these are Cherokee Prairies, Ozark Borders, and Ozarks (MDNR 1986). Alluvial soils along major stream courses are assigned to the Cherokee Prairies category.

Soils in the Cherokee Prairies region historically supported native vegetation comprised primarily of prairie grasses. These soils range from acidic poorly drained soils to soils which are excessively well drained, droughty, and infertile.

Ozarks soils are variable, and productivity encompasses a wide range. Ozarks soils may be stone free, but stone content can exceed 50 percent in some areas. Loess capped soils and soils located in valleys may be fertile and support improved pastures and grain farming.

The Ozark Borders region contains both forest soils and areas of transition between forest and prairie derived soils. Slope, parent materials, climate, and landforms all contribute to a wide variety of distinct soil types in this region.

Soil erosion ranges from 5 to 9 tons/acre/year from sheet and rill erosion on tilled lands, 2.5 to 5 tons/acre/year from sheet and rill erosion on permanent pasture, less than 0.25 tons/acre/year from sheet and rill erosion on non-grazed forests, and 100 to 199 tons/square mile from gully erosion.

Approximately 1.4 tons of sediments/acre/year actually reach impoundments and streams within the basin. The sources of eroded sediment are derived as followed: 76% from sheet and rill erosion; 14% from gully erosion; 3% from streambank erosion; and 7% from urban and built-up areas (Anderson 1980).

Figure 2. Missouri Natural Divisions map.

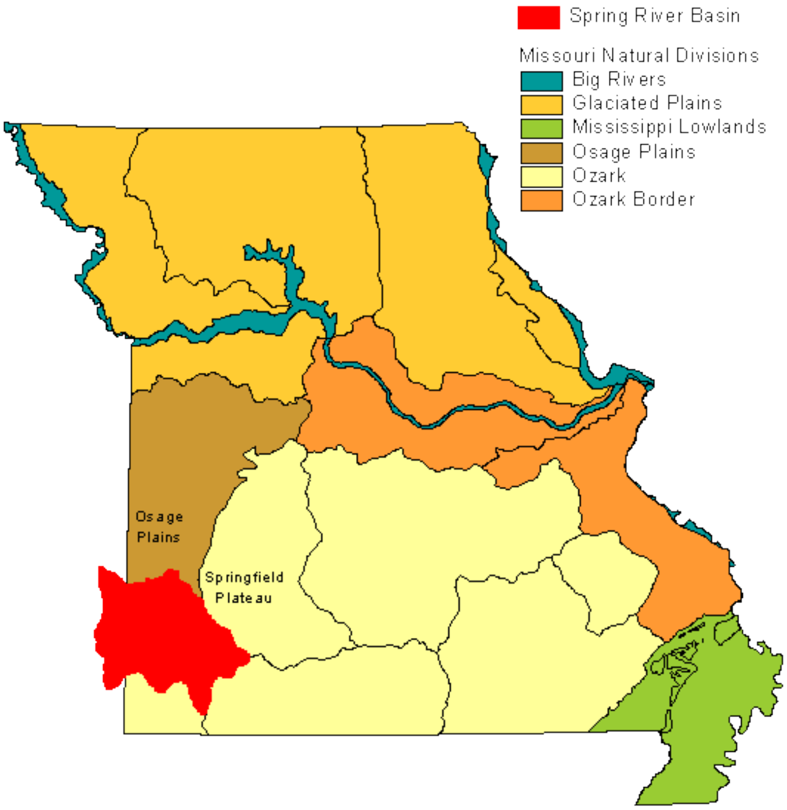


Table 1. Springs of the Spring River Basin.

SPRING NAME	NEAREST TOWN	COUNTY	T R S
Bartholic Spring*	Neosho	Newton	24N 31W 7
Bartoski Spring*	Fairview	Barry	24N 29W 3
Big Spring*	Neosho	Newton	25N 31W 19
Big Spring*	Mt Vernon	Lawrence	28N 27W 28
Boy Scout Spring*	Joplin	Newton	26N 32W 9
Button Spring*	Sarcoxie	Newton	27n 29w 21
Cave Spring	Sarcoxie	Jasper	28n 29w 26
Cave Spring*	Pierce City	Newton	25n 29w 11
Clarkson Spring*	Stotts City	Lawrence	27n 28w 17
Elm Spring*	Neosho	Newton	24n 31w 12
Fly Spring*	Purdy	Barry	24n 28w 16
Haddock Spring*	Sarcoxie	Newton	27n 29w 27
Hawkins Spring*	Pierce City	Barry	25n 29w 12
Hearrel Spring*	Neosho	Newton	25n 31w 30
Linn Spring	Sarcoxie	Newton	27n 29w 23
McMahan Spring*	Neosho	Newton	25n 31w 28
Means Spring	Pierce City	Barry	25n 28w 16
Monark Spring*	Neosho	Newton	25n 31w 26
Pierce City Spring*	Pierce City	Lawrence	26N 28W 20
Pioneer Spring*	Fairview	Barry	25N 29W 36
Polk Spring*	Marionville	Lawrence	27n 25w 22
Sagamount Spring*	Joplin	Newton	26N 32W 5
Talbert Spring*	Exeter	Barry	23n 28w 28
Unnamed*	Exeter	Barry	23n 28w 19
Unnamed	Fairview	Barry	24n 29w 10
Unnamed	Pierce City	Barry	25n 29w 12
Unnamed	Pierce City	Barry	25n 29w 12
Unnamed	Wheaton	Barry	24n 28w 30

SPRING NAME	NEAREST TOWN	COUNTY	T R S
Unnamed	Wheaton	Barry	24n 28w 33
Unnamed	Wheaton	Barry	23n 28w 6
Unnamed	Wheaton	Barry	24n 29w 14
Unnamed	Wheaton	Barry	24n 29w 14
Unnamed	Wheaton	Barry	24n 29w 23
Unnamed*	Wheaton	Barry	24n 29w 25
Unnamed	Sarcoxie	Jasper	27n 29w 9
Unnamed	Sarcoxie	Jasper	27n 30w 11
Unnamed	Miller	Lawrence	28n 26w 5
Unnamed	Stotts City	Lawrence	27n 28w 17
Unnamed*	Verona	Lawrence	26n 26w 17
Unnamed*	Granby	Newton	26n 30w 29
Unnamed	Granby	Newton	26n 31w 27
Unnamed	Joplin	Newton	27n 34w 27
Unnamed*	Newtonia	Newton	25n 29w 8
Unnamed	Newtonia	Newton	25n 29w 9
Unnamed	Newtonia	Newton	25n 29w 10
Unnamed	Newtonia	Newton	25n 29w 10
Unnamed	Newtonia	Newton	26n 29w 28
Unnamed	Ritchey	Newton	26n 29w 19
Unnamed	Ritchey	Newton	26n 29w 20
Unnamed*	Ritchey	Newton	26n 29w 32
Unnamed	Ritchey	Newton	26n 30w 21
Unnamed	Ritchey	Newton	26n 30w 23
Unnamed	Ritchey	Newton	26n 30w 27
Unnamed	Ritchey	Newton	26n 30w 27
Unnamed	Ritchey	Newton	26n 30w 27
Unnamed	Sarcoxie	Newton	27n 29w 27

Stream Order

Stream orders were assigned to all streams in the Missouri portions of the basin using 7.5 minute topographic maps. There are a total of 144 third order and larger streams in the basin. Of this total, 111 are third order, 20 are fourth order, six are fifth order, three are sixth order, and one (Spring River) reaches seventh order before leaving Missouri. Total stream mileages by order are: 1) third order - 593.8 miles; 2) fourth order - 256.8 miles; 3) fifth order - 106.7 miles; 4) sixth order - 225.0 miles; and 5) seventh order - 128.3 miles. Overall, third order and larger streams in the Missouri portion of the basin total 1, 310.5 miles. The major streams in the basin, with their respective lengths and orders are listed in Table 2.

Watershed Area

The basin has been divided into five major sub-basins, Upper Spring River, Lower Spring River/Center Creek, Shoal Creek, and upper and lower North Fork of the Spring River (Figures 2A-F). Table 2 contains watershed areas for fifth order and larger streams in the basin summarized from Funk (1968) or as determined using available 1:100, 000 scale topographic maps. The Spring River and its tributaries drain approximately 2, 271 square miles in Missouri. The three sixth order streams, North Fork of the Spring River, Shoal Creek, and Center Creek drain 640, 472, and 302 square miles, respectively. The fifth order streams have watersheds ranging from 39 to 100 square miles.

Channel Gradient

Stream gradient plots for all third order and larger streams were produced using U.S. Geological Survey (USGS) 7.5 minute topographic maps. This information is available from the Missouri Department of Conservation's (MDC) Southwest Regional Office in Springfield, MO. Average gradients were calculated for third order and larger reaches of the Spring River, North Fork of the Spring River, Shoal Creek, and Center Creek (Table 3).

Channel gradients reflect the transitional Ozarks/Prairie topography of the basin. The higher gradients of Shoal Creek are more typical of those found in Ozark streams, while the lower gradients of the North Fork of the Spring River are more typical of a prairie stream. The gradients for Spring River and Center Creek are intermediate between the two.

Table 2. Orders, total lengths, and watershed areas for major streams in the Spring River Basin.

Stream Code	Name	Order	Length (mi)	Area (mi2)
61220000	Spring River	7	125	2, 271
61210000	Center Creek	6	65.9	302
61225000	N. Fork Spring R.	6	80.7	640
61212000	Shoal Creek	6	78.4	472
61212270	Clear Creek	5	20.6	73
61225160	Dry Fork	5	20.6	95
61214210	Jones Creek	5	14.4	71
61225110	L.N. Fork Spring R.	5	21.9	100
61225260	Pettis Creek	5	14.5	39
61224100	Williams Creek	5	14.1	55

Table 3. Average gradients and percent slopes for stream reaches third order and larger on the Spring River, North Fork of the Spring River, Center Creek, and Shoal Creek.

Stream Name	Order	Avg. Gradient (ft/mile)	Percent/Slope
Spring River	7	2.33	0.42
	6	4.87	0.092
	5	6.27	0.119
	4	11.65	0.221
	3	26.32	0.498
North Fork	6	1.88	0.036
Spring River	5	3.96	0.075
	4*	<10.00*	<.189*
	3	22.22	0.421
Shoal Creek	6	5.72	0.108
	5	7.01	0.133
	4	14.24	0.27
	3	32.79	0.621
Center Creek	6	5.23	0.099
	5	7.26	0.138
	4	13.08	0.248
	3	21.05	0.399

*No contour lines transect this reach of the North Fork of the Spring River.

Land Use

Historic Land Use

Schroeder (1982) described the area along the western border of the Ozarks west of Springfield as follows:

> *"... prairies were different than elsewhere in the state. Here more than anywhere else prairies were discrete landscape units on a rolling-to-level upland, bounded by wide belts of timbered hill country along the stream valleys entrenched in the Ozark limestones. The undissected uplands were like the more extensive prairies to the west, and the stream valleys were like the Ozarks to the east (Schrader et al. 1954). Here the boundary between prairie and timber was sharpest. The floodplains of the larger streams were primarily wooded, but Schoolcraft noted prairies interspersed in the timber and cane (Schoolcraft 1821)."*

The Ozark portions of the basin were also described by Schroeder (1982) as follows:

> *"It was not as dense as the Appalachian wilderness, and this visual contrast did not go unnoticed in early accounts. Most familiar are Henry Rowe Schoolcraft's accounts of the open Ozark woods, replete with phrases such as "hills are stony and barren, covered with timber and high grass" Schoolcraft (1821).*
>
> *Curtis Marbut, relying on his own experience and that of the first settlers, wrote that "the greater part of the Ozark Dome...was up to the middle of the 19th century a region of open woods, large areas being almost treeless." (Marbut 1911)."*

Schroeder (1982) also described the area of west central Missouri that includes the region drained by the North Fork of the Spring River.

> *"It is sometimes called the Osage prairie or Osage plains of Missouri. Here prairies extended over all the rolling uplands. Timber was restricted to the valleys and, at that, often to riverbank fringes. Narrow strips of timber, called points, extended along drainageways into the upland prairies. From one point to another the prairie averaged four to five miles across...Barton County had the largest percentage of prairies (86 percent) of any Missouri county."*

Immigration into the Spring River, and across Missouri, accelerated during the first few decades of the nineteenth century. Legal land settlement (settlement on lands purchased from public domain) extended to Missouri's western border by 1821 (Schroeder 1982). Initially, most homesteads were located along streams and adjacent to bottomlands, and the prairies were used primarily for open range grazing. Some plowing and rowcrop farming began prior to the Civil War. Osage orange fence rows were established in Greene County as early as 1840 (Schroeder 1982). Significant efforts to control the fires that helped maintain the original prairie grasses soon followed.

Recent Land Use

The Spring River Basin is essentially rural, but because of the transitional nature of the basin's topography and relief, land use varies across the basin (Figure 1).

Land use in the North Fork of the Spring River area is approximately 85% rowcrop and pasture and 15% forested (MDNR 1984). No major urban areas are located in this sub-basin. Because of the relatively limited relief, little distinction exists between land use types in the bottomlands and uplands.

Land use in the Spring River portion of the basin is estimated at 70% rowcrop and pasture and 30% forested cover. The Center/Shoal Creek sub-basin has approximately 52% rowcrop and pasture, 45% forest cover, and 3% mined lands (MDNR 1984). Joplin is the major urban area located in this sub-basin. Forest lands are scattered. Many forested tracts are located along stream drainages in all sub-basins.

Mining has been an important industry in the area since the 1850s. Lead and zinc were the primary commodities with many other minerals exploited in smaller quantities (coal, limestone, marble, dolomite, silicon, and iron, to name a few). Lead and zinc mining ceased in the 1960s (Davis and Schumacher 1992).

There have been a total of 3, 337 mines recorded in the basin (MDNR 1996a). The number and types of mining operations vary among the counties (Table 4). Lead/zinc mines are more prevalent as a percentage of the total number of mines in Jasper, Lawrence, Barry, and Newton counties. Coal is the most common commodity mined in Barton County. Every county in the basin has limestone and sandstone mines. Cadmium, barium, and copper have been mined in Newton and Lawrence counties only.

Soil Conservation and Watershed Projects

There is one PL 566 project located in the basin; Hickory Creek near Neosho. This project is in the active planning and early implementation stage for flood prevention. There is one AgNPS/SALT project located on Shoal Creek in Barry County.

Public Areas

Public areas in the basin are depicted in Figures 3A-F and listed in Table 5. The Robert E. Talbot Conservation Area (CA) (4, 321 acres) and Shawnee Trail CA (3, 635 acres) are the largest public use areas in the basin. Lands originally purchased by the U.S. Department of the Army (Defense) near Neosho as part of Fort Crowder are now variously managed as Crowder College, Fort Crowder CA, Bicentennial CA, Fort Crowder Military Compound, and as portions of an industrial park. Other areas managed by the Missouri Department of Conservation include Catlin Prairie, Diamond Grove Prairie, Mon-Shon Prairie, Kickapoo Prairie, Mount Vernon Prairie, Treaty Line Prairie, Dorris Creek Prairie, Wildcat Glade, Pa Sole Prairie, and Wah-sha-she Prairie. Golden Prairie is owned and managed by the Missouri Prairie Foundation. Stream accesses managed by MDC are LaRussell Access on the Spring River; Stones Corner and Carl Junction accesses on Center Creek; Lamar Access on North Fork of the Spring River; and Tipton Ford, Allen Bridge, Lime Kiln, Wildcat, Smack-out, and Cherry Corner accesses on Shoal Creek. Kellogg Lake (25 acres) in Carthage and Williams Creek Park Lake in Mount Vernon are managed by the Department through Community Assistance Program (CAP) agreements.

The Missouri Department of Natural Resources (MDNR) owns and manages Battle of Carthage State Historic Site near Carthage. The U.S. Fish and Wildlife Service operates Neosho National Fish Hatchery in Neosho. The National Park Service owns and manages G.W. Carver National Monument near Diamond.

Corps of Engineers Jurisdiction

The Spring River Basin is under the jurisdiction of the Little Rock District of the U.S. Army Corps of Engineers (COE). Permits issued under Section 404 of the federal Clean Water Act are required to conduct many instream activities. Applications for Section 404 permits should be directed to the Little Rock office. In addition, current listings of Section 404 permits are available from the Little Rock COE District Office:

Little Rock District Phone: (501)324-5295 Corps of Engineers
P.O. Box 867
Little Rock, AR 72203-0867

Figure 1. Land use of the Spring River watershed.

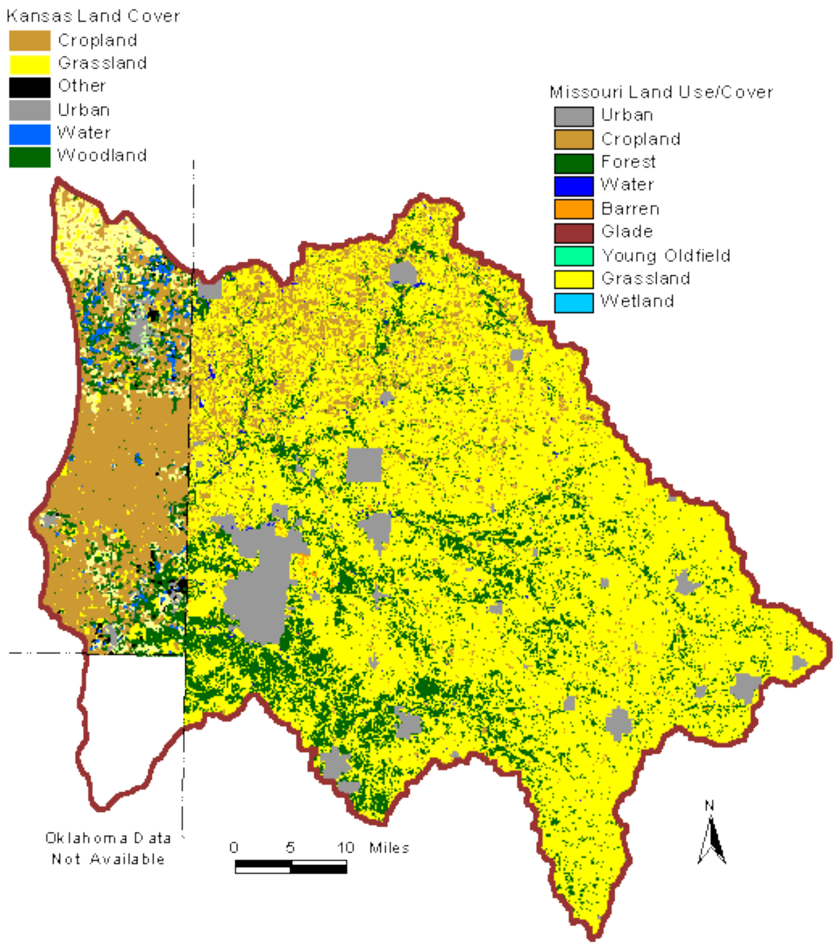


Table 4. Mine types described by county in the Spring River Basin.

COMMODITY	BARRY	BARTON	JASPER	LAWRENCE	NEWTON
Lead/zinc	17	0	1,824	462	762
Sand/gravel	0	4	4	0	2
Limestone	5	16	38	17	19
Silicon	0	0	1	0	0
Zinc/clay	0	0	3	0	1
Coal	0	38	12	0	0
Zinc	1	0	18	11	15
Sandstone	2	2	2	7	1
Iron	0	4	4	12	0
Lead	0	0	1	1	6
Coal/bituminous	1	2	0	0	0
Clay	0	2	0	4	0
Sand/gravel	0	4	0	0	2
Cadmium/zinc	0	0	0	0	1
Coal/zinc	0	0	0	0	1
Barium/iron	0	0	0	1	0
Clay-kaolin	0	0	0	1	0
Clay/iron	0	0	0	1	0
Lead/copper	0	0	0	1	0
Total	28	68	1,908	524	809

Source: MDNR (1996a).

Table 5. Missouri Department of Conservation public areas in the Spring River Basin.

AREA NAME	IMPOUNDMENT ACRES	LAND ACRES	MAJOR STREAMS
Allen Bridge Access	0	15	**Shoal Creek**
Catlin Prairie CA	15	260	
Bicentennial CA	>1	721	
Capps Creek CA	0	120	**Capps Creek**
Carl Junction Access	0	3	**Center Creek**
Cherry Corner Access	0	4	**Shoal Creek**
Diamond Grove Prairie CA	0	611	**Turkey Creek**
Dorris Creek Prairie CA	10	160	**Dorris Creek**
Fort Crowder CA	<2	2,362	
Hickory Creek CAP	0	1	**Hickory Creek**
Kellogg City Lake	25	25	
Kickapoo Prairie CA	0	160	
La Russell Access	0	1	**Spring River**
Lamar Access	0	30	**North Fork of the Spring River**
Lime Kiln Access	0	11	**Shoal Creek**
Mon-Shon Prairie CA	<1	80	
Mount Vernon Prairie	0	41	
Neosho Towersite	0	70	
Pa Sole Prairie CA	0	240	
Shawnee Trail CA	113	3,635	
Smackout Access	0	1	**Shoal Creek**
Stones Corner Access	0	9	**Center Creek**
Talbot CA	45	4,321	**Spring River**
Tipton Ford Access	0	90	**Shoal Creek**
Treaty Line Prairie CA	0	168	
Wah-Sha-She Prairie	0	160	

AREA NAME	IMPOUNDMENT ACRES	LAND ACRES	MAJOR STREAMS
Walter Woods CA	1	28	
Wildcat Access	0	1	**Shoal Creek**
Wildcat Glade NA	0	17	
Williams Creek Park	**3**	**3**	**Williams Creek**

Hydrology

Precipitation

The average annual rainfall is 43.86 inches (Missouri Agricultural Experiment Station 1995).

Gaging Stations

The United States Geological Survey (USGS) has maintained gaging stations and water quality monitoring stations throughout the basin (Figures 2A-F). The following list includes the gaging stations found in the basin with location and period of record listed (USGS 1986, 1987, 1988, 1989, 1991, 1993, 1994, 1995). Numbers 1-3, 10, and 11 are currently operating.

Gage sites:

- Spring River near Waco, located at lat. 37degrees 14'44", long. 94degrees 33'58", on the line between SE1/4 S7 and NE1/4 S18, T29N, R33W, in Jasper County on the downstream side of the left pier of a county highway bridge, 0.8 miles downstream from Blackberry Creek, 1.5 miles east of Waco, and 47.6 miles upstream from the mouth. Period of record, April 1924 to present.
- Center Creek below Carl Junction, located at lat. 37degrees 09'39", long. 94degrees 34'51", in NE1/4 SE1/4 SE1/4 S12, T28N, R33W, in Jasper County on the downstream end of the left bridge pier on state Highway JJ, 2.4 miles upstream from Spring River, and one mile southwest of Carl Junction. Period of record, April 1993 to present.
- Shoal Creek above Joplin, located at lat. 37degrees 01'23", long. 94degrees 30'58", in SE1/4 NE1/4 S34, T27N, R33W, in Newton County on the right bank 250 feet upstream from the mouth of Spring Creek, 1, 400 feet downstream from the bridge on state Highway 86, 0.5 miles south of the city limits of Joplin, and 13.2 miles above the mouth. Period of record, October 1941 to present.
- Center Creek near Carterville, located at lat. 37degrees 08'26", long. 94degrees 22'57", in NW1/4 NW1/4 NW1/4 S24, T28N, R32W, in Jasper County on the downstream side of the right pier of the bridge on State Highway HH, 1.5 miles downstream from Grove Creek, 3.0 miles east of Carterville, and 17.0 miles above the mouth. Period of record, June 1962 to September 1991.
- Stahl Creek near Miller, located at lat. 37degrees 11'40", long. 93degrees 50'40", in SE1/4 S26, T29N, R27W, in Lawrence County, at the bridge on state Highway 39, 1.5 miles south of Miller, and 6.4 miles upstream from the confluence with the Spring River. Period of record, 1950-1976.
- Spring River at La Russell, located at lat. 37degrees 09'13", long. 94degrees 03'21", in SW1/4 SW1/4 S12, T28N, R29W, Lawrence and Jasper county line, on the right bank on the upstream side of Bower Mills bridge, 0.8 miles north of La Russell, and 2.5 miles upstream from Cave Spring Branch. Period of record, 1947-1981.
- Spring River at Carthage, located at lat. 37degrees 11'11", long. 94degrees 18'56", in N1/4 SW1/4 SE1/4 S33, T29N, R31W, on the downstream side of the second pier from left abutment of the Missouri Pacific Railroad bridge in Carthage, and 600 feet downstream from the U.S. Highway 71 bridge. Period of record, 1966-1980.
- Turkey Creek near Joplin, located at lat. 37degrees 07'15", long. 94 degrees34'55", in NE1/4 SE1/4 S25, T28N, R34W, at the downstream side of the right pier of the bridge on County Highway P, 15 miles upstream from the mouth, and 3 miles northwest of Joplin. Period of record, 1963-1972.

Water quality sites:

- Center Creek near Smithfield, located at lat. 37degrees 09'20", long. 94degrees 36'10", in NE1/4 SW1/4 NE1/4 S14, T28N, R34W, in Jasper County at the bridge on a county road, one mile south

of Smithville, and one mile above the mouth. Period of record, October 1968 to July 1975; July 1977 to June 1989; April 1993 to August 1995.

- Spring River near Waco, located at lat. 37 degrees14'44", long. 94degrees 33'58", on the line between SE1/4 S7 and NE1/4 S18, T29N, R33W, in Jasper County on the downstream side of the left pier of the county highway bridge, 0.8 miles downstream from Blackberry Creek, 1.5 miles east of Waco, and 47.6 miles upstream from the mouth. Period of record, April 1924 to present.
- Shoal Creek above Joplin, located at lat. 37degrees 01'23", long. 94 degrees30'58", in SE1/4 NE1/4 S34, T27N, R33W, in Newton County on the right bank 250 feet upstream from the mouth of Spring Creek, 1, 400 feet downstream from the bridge on state Highway 86, 0.5 miles south of the city limits of Joplin, and 13.2 miles above the mouth. Period of record, October 1941 to present.
- Center Creek near Carterville, located at lat. 37degrees 08'26", long. 94degrees 22'57", in NW1/4 NW1/4 NW1/4 S24, T28N, R32W, in Jasper County on the downstream side of the right pier of the bridge on state Highway HH, 1.5 miles downstream from Grove Creek, 3.0 miles east of Carterville, and
- 17.0 miles above the mouth. Period of record, June 1962 to September 1991.
- Spring River near Thayer, located at lat. 36degrees 30'10", long. 91degrees 31'31". Period of record, 1969-1975.
- Turkey Creek near Joplin, located at lat. 37degrees 07'15", long. 94 degrees34'55", in NE1/4 SE1/4 S25, T28N, R34W, at the downstream side of the right pier of the bridge on County Highway P, 15 miles upstream from the mouth, and 3 miles northwest of Joplin. Period of record, 1963-1972.
- Shoal Creek near Galena, Kansas, located at lat. 37degrees 02'31", long. 94degrees 38'34", in SW1/4 NE1/4 NW1/4 S35, T34S, R25E. Period of record, 1968-1975.

Permanent/Intermittent Streams

There are many streams in the watershed which are intermittent for part or all of their reach. The total mileage for intermittent streams with permanent pools is 188 miles. The length of streams with permanent flow is 331 miles (Funk 1968). Mileages for intermittent streams with permanent pools are included in Table 6. Losing stream reaches are listed in Table 7 and Figures 4A-F.

Stream Flow

The peak discharge for the gages located on the Spring River at Waco, Center Creek below Carl Junction, and Shoal Creek above Joplin, occurs in May (USGS 1995). The average annual mean discharge for the Spring River location is 945 cubic feet per second (cfs). The highest annual mean for this gage was 3, 093 cfs in 1993, and the lowest mean was 61.4 cfs recorded in 1954. The average annual mean discharge for the Center Creek location is 418 cfs, with the lowest mean of 328 cfs recorded in 1994. The highest annual mean for this location was 508 cfs in 1995. The average annual mean discharge for the Shoal Creek station is 431 cfs. The highest mean for this location was 1, 221 cfs in 1993, and the lowest recorded annual mean was 77.8 cfs in 1954.

The 7-day Q2 and Q10 values represent the relative permanence of a stream. The 7-day low flow discharges, with recurrence intervals of two years (Q2) and ten years (Q10), for locations throughout the basin are found in Table 8.

Dams and Hydropower Influences

There are three impoundments in the watershed with surface areas greater than 50 acres. Only one, the Joplin Water Supply Lake (Shoal Creek), impounds a major stream. Maximum water withdrawal at this site is 14 cfs, and the dam completely impounds the stream in periods of drought or low flow (MDNR

1984). Blackberry Hay Farm Lake impounds a portion of Pond Creek in Jasper County and is under private ownership. Lamar City Lake is used for Lamar city water supply and recreation. It is located in Barton County and impounds an unnamed tributary (MDNR 1984).

Table 6. Intermittent streams with permanent pools in the Spring River Basin.

STREAM NAME	COUNTY	TOTAL MILES WITH PERMANENT POOLS
Clear Creek	Barry-Newton	3.5
Lateral to Shoal Creek	Barry	5
Lateral to Shoal Creek	Barry	3
Shoal Creek	Barry-Kansas Line	4
South Fork Capps Creek	Barry-Newton	3
Blackberry Creek	Barton-Jasper	6.5
Dicks Fork	Barton	2.5
Lateral to Little North Fork	Barton	4
Lateral to North Fork Spring River	Barton	0.5
Lateral to Pettis Creek	Barton	0.5
Little North Fork	Barton-Jasper	13
Little Spring River	Barton-Jasper	3.5
Muddy River	Barton	0.5
North Fork Spring River	Barton-Jasper	16.5
Pettis Creek	Barton	6
Honey Creek	Christian-Lawrence	6.5
Muddy Fork	Dade-Barton	16.5
Buck Branch	Jasper	5.5
Cave Spring Branch	Jasper	1
Coon Creek	Jasper-Barton	9.5
Cutoff to North Fork Spring River	Jasper	2
Cutoff to North Fork Spring River	Jasper	0.5
Dry Creek	Jasper	9
Lateral to Blackberry Creek	Jasper	3.5
Lateral to Coon Creek	Jasper-Barton	2
Lateral to North Fork Spring River	Jasper	2
Coon Creek	Lawrence-Dade	8.5
Douger Branch	Lawrence	4.5
Dry Fork	Lawrence	2
Dry Hollow	Lawrence	0.5
Dry Valley Branch	Lawrence-Newton	1.5
Lateral to North Fork Spring River	Lawrence	0.5
Lateral to North Fork Spring River	Lawrence	1
Lateral to Stahl Creek	Lawrence	0.5
Lateral to White Oak Creek	Lawrence	5
Lateral to Williams Creek	Lawrence	0.5
Lateral to Williams Creek	Lawrence	0.5
Spring River	Lawrence-Kansas Line	1.5
Stahl Creek	Lawrence	1.5

STREAM NAME	COUNTY	TOTAL MILES WITH PERMANENT POOLS
Truitt Creek	Lawrence	5
White Oak Creek	Lawrence-Jasper	11.5
Williams Creek	Lawrence	1.5
Elm Spring Branch	Newton	1
Hickory Creek	Newton	0.5
Jenkins Creek	Newton-Jasper	2.5
Lateral to Center Creek	Newton	1.5
Lateral to Elm Spring Branch	Newton	0.5
Warren Branch	Newton-Kansas Line	1.5

Source: Funk (1968).

Table 7. Losing stream reaches in the Spring River Basin.

STREAM NAME	FIRST COUNTY	SECOND COUNTY	LENGTH (mi)	LEGAL START (T R S)	LEGAL END (T R S)
Browning Hollow	Barry	Lawrence	3	N, NW, SE 26N 27W 36	SE, SW, NE 26N 26W 20
Clear Creek	Barry	—	4	SE, NE, NW 25N 27W 10	SE, SE, SW 26N 27W 31
Unnamed Trib to Clear Creek	Barry	—	1	SW, NW, SW 25N 28W 1	NE, SE, SW 26N 28W 36
Unnamed Trib to Clear Creek	Barry	—	1	SE, SE, NW 25N 28W 2	SW, SE, NE 26N 28W 35
Unnamed Trib to Clear Creek	Barry	—	1	NW, SE, SE 26N 28W 35	NE, NE, SE 26N 28W 35
Unnamed Trib to Clear Creek	Barry	Lawrence	1.5	NE, SW, SW 26N 28W 34	NW, NW, SE 26N 28W 27
Hudson Creek	Barry	—	4	SW, SW, SE 25N 28W 13	SW, NW, NW 25N 28W 16
Kelly Creek	Barry	—	5	SE, SE, SW 25N 27W 2	SW, SE, SW 26N 27W 31
South Fork of Capps Creek	Barry	—	5	SW, SW, SW 24N 28W 3	SE, SE, NW 25N 28W 21
South Indian Creek	Barry	Newton	2.4	NW, SE, NE 24N 29W 33	NW, NW, SE 24N 29W 31
Spring River	Barry	Lawrence	4	SE, NW, SE 26N 26W 36	SE, SW, NE 26N 26W 20
Unnamed Trib to Spring River	Barry	Lawrence	1	NE, NE, SW 26N 26W 35	NW, SE, SW 26N 26W 26
Unnamed Trib to Shoal Creek	Barry	—	2.5	NW, SE, NE 24N 28W 10	NW, SW, NW 24N 28W 16
Fidelity Branch	Jasper	—	3.5	SW, SE, SW 27N 31W 15	NE, NW, NE 27N 31W 3
Grove Creek	Jasper	—	1.5	NE, SW, NE 27N 32W 11	NW, SE, NW 27N 32W 1
Unnamed Trib to Center Creek	Jasper	—	2.5	SW, SE, NW 28N 33W 23	NW, NW, SW 28N 33W 10
Unnamed Trib to Jenkins Creek	Jasper	—	1.8	SW, SW, SW 27N 30W 5	SE, NE, SW 27N 30W 7

STREAM NAME	FIRST COUNTY	SECOND COUNTY	LENGTH (mi)	LEGAL START (T R S)	LEGAL END (T R S)
Unnamed Trib to Motley Branch	Jasper	—	0.8	SW, NW, NW 27N 30W 12	SW, NW, NW 27N 30W 12
Short Creek	Jasper	—	1.5	NW, NE, NE 27N 34W 12	NW, NW, SW 27N 34W 2
Unnamed Trib to Short Creek	Jasper	—	3	NE, NE, SW 27N 33W 18	SE, SE, SW 27N 34W 2
Browning Hollow	Lawrence	—	5	SE, SW, SE 27N 26W 34	SW, SW, NW 27N 26W 30
Unnamed Trib to Browning Hol	Lawrence	—	1.3	NW, SW, SW 27N 26W 33	SE, NW, SE 27N 26W 29
Unnamed Trib to Browning Hol	Lawrence	—	1	NE, NE, SE 26N 26W 4	SW, NE, SE 27N 26W 33
Unnamed Trib to Browning Hol	Lawrence	—	0.5	SE, NE, NW 26N 26W 3	SE, NE, SE 27N 26W 33
Unnamed Trib to Browning Hol	Lawrence	—	1	SE, NW, SE 27N 26W 28	SW, NW, SW 27N 26W 28
Unnamed Trib to Borwning Hol	Lawrence	—	0.5	SW, SW, SW 27N 26W 27	SW, NW, SE 27N 26W 28
Douger Branch	Lawrence	—	2.5	NW, NE, SW 26N 26W 11	NW, NW, SW 26N 26W 9
Unnamed Trib to Douger Branch	Lawrence	—	1	SW, SW, SE 26N 26W 10	NW, NE, SE 26N 26W 9
Unnamed Trib to Douger Branch	Lawrence	—	0.8	NW, SE, NW 26N 26W 10	SE, SW, NE 26N 26W 9
Unnamed Trib to Douger Branch	Lawrence	—	0.8	NW, SW, SE 26N 26W 3	NW, NW, SE 26N 26W 10
Unnamed Trib to Douger Branch	Lawrence	—	0.8	SE, NE, SE 26N 26W 3	NW, NW, SE 26N 26W 11
Unnamed Trib to Douger Branch	Lawrence	—	0.5	SW, NE, NW 26N 26W 11	NW, NE, SW 26N 26W 11
Dry Hollow	Lawrence	—	8	SW, SE, NW 27N 28W 24	NE, SW, SW 28N 28W 15
Unnamed Trib to Dry Hollow	Lawrence	—	0.8	SE, SE, NW 27N 28W 2	SE, NE, NE 27N 28W 2
Unnamed Trib to Dry	Lawrence	—	0.8	SW, NW, SW	NW, SW, NE

STREAM NAME	FIRST COUNTY	SECOND COUNTY	LENGTH (mi)	LEGAL START (T R S)	LEGAL END (T R S)
Hollow				27N 28W 11	27N 28W 11
Unnamed Trib to Dry Hollow	Lawrence	—	0.5	NE, NW, NE 27N 28W 14	SE, NE, SW 27N 28W 11
Hillhouse Branch	Lawrence	—	3	NE, NE, NE 26N 27W 15	SW, SE, SE 27N 27W 36
Unnamed Trib to Hillhouse Cr	Lawrence	—	0.5	NE, SE, SW 26N 27W 11	NE, SW, NW 26N 27W 11
Unnamed Trib to Hillhouse Cr	Lawrence	—	0.5	SW, SE, SW 26N 27W 10	SW, SW, NW 26N 27W 11
Unnamed Trib to Hillhouse Cr	Lawrence	—	0.5	SW, SW, NW 26N 27W 2	SE, NE, SW 26N 27W 2
Unnamed Trib to Hillhouse Cr	Lawrence	—	1	NW, NW, NW 26N 27W 2	SE, SW, NW 26N 27W 1
Honey Creek	Lawrence	—	9	NE, NE, SE 27N 26W 13	NW, NE, SE 27N 27W 3
Unnamed Trib to Honey Creek	Lawrence	—	2.8	NE, NE, SW 27N 25W 5	NE, NE, SE 27N 26W 13
Unnamed Trib to Honey Creek	Lawrence	—	0.3	SW, NW, SW 27N 26W 9	SW, SE, SW 27N 26W 9
Unnamed Trib to Honey Creek	Lawrence	—	1.8	SW, SW, NE 27N 26W 4	NE, SE, SW 27N 26W 9
Unnamed Trib to Honey Creek	Lawrence	—	0.5	SW, NE, SW 27N 26W 12	SW, SE, SE 27N 26W 12
Unnamed Trib to Honey Creek	Lawrence	—	3	SE, SE, NW 27N 26W 3	NW, SE, SW 27N 26W 16
Unnamed Trib to Honey Creek	Lawrence	—	1	SW, SE, SW 27N 25W 4	SE, SW, NE 27N 25W 17
Unnamed Trib to Honey Creek	Lawrence	—	1.5	NE, NW, NW 27N 25W 9	SE, SW, NE 27N 25W 17
Unnamed Trib to Honey Creek	Lawrence	—	1.5	NW, NE, NE 27N 26W 12	NE, NW, SE 27N 26W 13
Unnamed Trib to Honey Creek			(mi)	(T R S)	(T R S)
Hewlett Branch	Lawrence	—	1	NW, NW, NE 27N 25W 33	SW, NW, NE 27N 25W 28

STREAM NAME	FIRST COUNTY	SECOND COUNTY	LENGTH (mi)	LEGAL START (T R S)	LEGAL END (T R S)
Unnamed Trib to Hewlett Br	Lawrence	—	4.5	NW, SW, SE 26N 27W 18	SW, SW, SW 27N 28W 25
Unnamed Trib to Hewlett Br	Lawrence	—	1.5	NW, SW, NE 26N 27W 7	SW, SW, NE 26N 28W 1
Pruitt Branch	Lawrence	—	1.3	SW, NE, SW 26N 27W 6	NE, NE, NW 26N 28W 1
Unnamed Trib to Spring River	Lawrence	—	3	SE, NE, SW 26N 28W 11	NE, SW, SW 27N 28W 26
Unnamed Trib to Spring River	Lawrence	—	1.5	NE, NE, SW 27N 27W 21	SW, NW, NW 27N 27W 16
Unnamed Trib to Spring River	Lawrence	—	1	NE, NW, SW 27N 27W 21	NE, SE, SW 27N 27W 17
Unnamed Trib to Spring River	Lawrence	—	0.8	NW, SE, SE 27N 27W 20	SE, SE, NW 27N 27W 20
Unnamed Trib to Spring River	Lawrence	—	1	NW, SW, NE 27N 27W 19	SE, NE, NW 27N 27W 20
Unnamed Trib to Spring River	Lawrence	—	1	SW, NW, SE 27N 27W 18	NE, SE, SW 27N 27W 17
Unnamed Trib to Spring River	Lawrence	—	1.3	NE, NW, SW 27N 27W 8	SW, NE, SE 27N 27W 5
Unnamed Trib to Spring River	Lawrence	—	0.8	NW, SE, SW 27N 27W 5	NW, NE, SE 27N 27W 5
Unnamed Trib to Spring River	Lawrence	—	1	SW, NW, SW 27N 27W 5	SW, NE, NE 27N 27W 5
Unnamed Trib to Spring River	Lawrence	—	1	SW, NW, NW 27N 27W 5	NW, NE, SE 28N 27W 32
Unnamed Trib to Spring River	Lawrence	—	0.5	SE, NW, SW 28N 27W 32	NW, SW, SE 28N 27W 32
Unnamed Trib to Spring River	Lawrence	—	0.8	NE, SW, NW 28N 27W 32	NW, SE, NE 28N 27W 32
Unnamed Trib to Spring River	Lawrence	—	0.3	SW, NE, SW 28N 27W 33	NW, SE, SE 28N 27W 32
Unnamed Trib to Spring River	Lawrence	—	0.5	SE, SE, SE 26N 26W 5	SE, SE, SW 26N 26W 5
Unnamed Trib to	Lawrence	—	6.5	NE, NW, SE	SE, NE, SE

STREAM NAME	FIRST COUNTY	SECOND COUNTY	LENGTH (mi)	LEGAL START (T R S)	LEGAL END (T R S)
Spring River				27N 27W 29	28N 27W 29
Unnamed Trib to Stahl Creek	Lawrence	—	2.5	SW, SW, SW 26N 26W 18	SE, SE, SW 26N 26W 5
Unnamed Trib to Clear Creek	Lawrence	—	1.3	NE, NE, SW 29N 27W 24	SE, SW, NW 29N 27W 25
Unnamed Trib to Clear Creek	Lawrence	—	0.4	SE, SE, SE 26N 28W 27	NE, NE, SE 26N 28W 27
Unnamed Trib to Clear Creek	Lawrence	—	0.2	SE, NW, SW 26N 27W 30	NW, SW, SW 26N 27W 30
Five Mile Creek	Lawrence	Barry	4.3	SE, NE, SE 26N 27W 20	SW, NW, NE 26N 28W 35
Unnamed Trib to Five Mile Cr	Newton	—	2	NW, NE, NW 26N 33W 34	NW, NE, NW 26N 33W 28
Jones Creek	Newton	—	2.6	SW, SE, NE 26N 34W 12	NW, NE, SE 26N 33W 5
Spring Creek	Newton	Jasper	4	NW, SW, NW 27N 31W 24	NE, NW, SE 27N 31W 2
Unnamed Trib to Hickory Creek	Newton	—	2	SE, NE, SW 26N 33W 4	SW, NE, SE 27N 33W 34
Unnamed Trib to Shoal Creek	Newton	—	2	SE, SW, SE 24N 32W 3	SW, SW, NE 25N 31W 30
Unnamed Trib to Shoal Creek	Newton	—	3.7	NW, SE, NE 27N 32W 21	CENTER 27N 32W 31
	Newton	—	3.3	NE, SE, NW 27N 32W 27	NW, SE, SE 27N 32W 30

Source: Duchrow (1991).

Table 8. Seven-day low flow discharges (cfs) with recurrence intervals of two years (Q2) and ten years (Q10) for the Spring River Basin.

STREAM	LOCATION	PERIOD OF RECORD	7-DAY Q2	7-DAY Q10
Big Spring	Mt. Vernon	1925-66	16	9
Big Spring	Neosho	1925-64	1.2	
Boy Scout Camp Spring	Joplin	1964-65	0.6	
Brickhouse Spring	Neosho	1959-64	1.3	
Capps Creek	Berwick	1962-70	20	11
Center Creek	Carl Junction	1943-70	35	13
Center Creek	Carterville	1962-91	26	9.4
Center Creek	Fidelity	1962-70	22	7.6
Center Creek	Sarcoxie	1954-67	16	6.8
Center Creek	Webb City	1962-66	32	10
Clarkson Spring	Pierce City	1941-66	7.5	
Clear Creek	Richey	1953-67	7	2.2
Elm Spring	Neosho	1959-61	0.4	
Hickory Creek	Neosho	1941-70	9.8	3.9
McMahon Spring	Neosho	1943-64	1	
North Fork	Lamar	1943-63	0.1	0
North Fork	Galesburg	1947-64	4.7	2
Shoal Creek	Fairview	1954-67	17	7
Shoal Creek	Joplin	1941-91	92	35
Shoal Creek	Neosho	1941-67	60	23
Shoal Creek	Richey	1945-70	54	20
Spring River	Carthage	1951-80	50	19
Spring River	La Russell	1957-81	47	20
Spring River	Neck City	1954-64	51	
Spring River	Stotts City	1943-67	42	19
Spring River	Verona	1953-64	5	3.2

STREAM	LOCATION	PERIOD OF RECORD	7-DAY Q2	7-DAY Q10
Spring River	Waco	1924-92	53	18
Stahl Creek	Miller	1952-72	0	0
Ozark Trout Farm Spring	Neosho	1954-65	1.4	0.9
Williams Creek	Mt. Vernon	1954-67	4.7	2

Source: MDNR (1996b).

Water Quality

Beneficial Use Attainment

The basin has streams classified for all beneficial uses designated by the Missouri Department of Natural Resources (MDNR 1996c) (Table 9).

In addition to stream use classifications, there are three lakes which have been given beneficial use designations. These are: Oscie Ora Acres, a 50-acre Class 3 lake located at T28N, R33W, S10 in Jasper County-classified for livestock watering and aquatic life; Kellogg Lake, a 25-acre Class 3 lake located at T29N, R31W, S34 in Jasper County-classified for livestock watering, aquatic life, whole body contact recreation, and boating; and Lamar City Lake, a 180-acre Class 4 lake located at T32N, R30W, S32 in Barton County-classified for livestock watering, aquatic life, and drinking water supply.

Chemical Quality, Contamination, and Fish Kills

In the early days of mining in the area, acid-mine water was pumped into the streams as a result of dewatering the mines. Poor water quality has become the end result of this practice (Davis and Schumacher 1992). The effect this practice has had on the streams in the basin has been reviewed by Davis and Schumacher (1992) and is evident from the summaries (taken from Davis and Schumacher 1992) listed below.

The Oronogo-Duenweg mining belt is found almost entirely within the Center Creek sub-basin. Discharges from mining operations have affected the lower portion of the stream. Artesian flow from shafts and subsurface seepage are the primary sources of contamination during low-flow. Seepage and runoff from tailing piles are the principle sources of contamination in the stream during high flow.

In addition, nitrate and ammonia are discharged into Center Creek from local industries causing the nitrogen levels to exceed the standard discharge allowance during periods of low-flow. Biological summaries of the area indicate that the water quality above Grove Creek is good while that below Grove Creek declines. Some improvement did occur immediately downstream from Grove Creek in the 1980s, possibly due to better quality control.

Turkey Creek is one of the most polluted streams of the region based on benthic collections and chemical analysis (Missouri Clean Water Commission 1974). The creek receives effluent from wastewater facilities, industry, and abandoned mines and tailing piles (Davis and Schumacher 1992).

Short Creek has water quality problems as a result of mine-water seepage and runoff from a smelter plant. Benthic life was limited to filamentous algae (Davis and Schumacher 1992).

Shoal Creek has been identified as having very good water quality. Adverse impacts on the stream are minimal and consist of effluent from the Joplin and Neosho treatment facilities which had problems only historically. Since these facilities were renovated, the stream has had no pollution problems associated with the facilities.

The headwaters of the Spring River are characterized by good chemical and biological water quality. Water quality has been affected by dioxin in the Verona area. Further downstream, the river is affected by industrial and municipal discharges. Even downstream, the chemical and biological quality of the water remains good.

Davis and Schumacher (1992) completed a thorough summary of the chemical water quality characteristics of the basin in Missouri and Kansas. Extensive statistical tests were conducted to determine water quality upstream from the major tributaries and mining influence (Spring River near Waco) and downstream from all the major tributaries (Baxter Springs, Kansas). The water quality and chemical property summaries (Table 10) are taken from Davis and Schumacher (1992).

Center, Turkey, and Short creeks drain approximately 93% of the lead-zinc mined areas of the watershed.

These creeks drain 70%, 18%, and 5% of this area, respectively. High concentrations of calcium, sulfate, dissolved solids, and zinc reflect this. In addition, these three streams are affected by municipal and industrial discharges. The water quality of the Spring River deteriorates downstream from these streams.

There are substantial effects of mining on water quality downstream from Center Creek near Smithfield and Turkey Creek near Joplin. Spearman rank coefficients become less negative moving upstream from the areas influenced by mining.

Total phosphorus concentrations decrease downstream from the Center Creek stations due to the aging of the phospho-gypsum piles and the decrease in use of phosphate containing detergents.

There are downward trends in sulfate concentrations, specific conductance, calcium, and zinc concentrations at the stations which were affected by mining (Center Creek near Smithfield, Turkey Creek near Joplin, and Spring River near Baxter Springs, Kansas). In addition, increasing trends for pH values at these stations indicate that water quality in the watershed is improving with time.

A Level III health advisory was issued during the late 1980s for all fish species in the Spring River between Verona and Hoberg in Lawrence County due to dioxin contamination from runoff at a manufacturing plant near Verona. A level III advisory is issued for a species or area if most of the fish which are tested have contaminant concentrations above levels of concern. Under this advisory, the specified fish should not be eaten. This advisory was lifted in 1993. There are currently no advisories listed for the basin.

Fish kills have been investigated throughout the watershed since the 1970s. Eighty-two fish kills were investigated between 1979 and 1994 (Table 11). Of these, 18 were from Grove Creek, seven from Turkey Creek, and five from Center Creek. Industrial and municipal sources are the most common causes cited for fish kills in the investigation reports.

Water Use

Many of the municipalities in the basin use wells for all or part of their public water supplies. These municipalities are Aurora, Diamond, Freistatt, Granby, Jasper, Joplin, Monett, Neosho, and Pierce City.

The basin also has three public water supply surface withdrawals. These are: Lamar Lake for the City of Lamar, SW, SW T32N, R30W, S32; Shoal Creek for the City of Joplin, NE, NE T27N, R33W, S28; and Shoal Creek for the City of Neosho, SW, SW T25N, R31W, S7 (MDNR 1996b).

Point Source Pollution

Point source pollution in the basin affects the main stem of the Spring River, the major sub-basins in the watershed, as well as several smaller tributaries. There are sewage treatment facilities which discharge into streams located near Alba, Aurora, Carl Junction, Carthage, Diamond, Freistatt, Golden City, Granby, Jasper, Joplin, Lamar, Marionville, Miller, Monett, Mt. Vernon, Neosho, Pierce City, Sarcoxie, Stotts City, and Verona.

There are industries, subdivisions, mobile home parks, mines, and motels which also have permits to discharge into streams in the area. The Neosho National Fish Hatchery, operated by the U.S. Fish and Wildlife Service (USFWS), also has a permit to discharge into Hickory Creek near Neosho. Grove Creek, Center Creek, Shoal Creek, Turkey Creek, and the mainstem of the Spring River seem to be the most heavily impacted. A list of the permitted point sources in the basin is found in Table 12. Stormwater permits for the region are found in Table 13. To report incidents of pollution contact the Department of Natural Resources.

Nonpoint Source Pollution

Several sources of nonpoint pollution have been identified in the watershed (MDNR 1996b). The majority of the nonpoint problems identified are problems associated with mining (chat, tailings, or outfalls) or

animal husbandry (turkey or poultry and dairy operations). The North Fork of the Spring River has a basin-wide nonpoint source problem associated with farming chemicals which have reached the groundwater supply (MDNR 1996b). Trihalomethanes have also been found in the Lamar Lake watershed drinking supply. Industrial waste, various chemicals (NH_3-N and dioxin), high fecal coliform levels, and groundwater contamination with oil have also been identified as sources of nonpoint pollution problems in the basin. Site descriptions for nonpoint pollution sources given by MDNR (1996b) are listed in Table 14.

AQL—Protection of Warm Water Aquatic Life and Human Health- Fish Consumption

CLF—Cool Water Fishery

CDF—Cold Water Fishery

WBC—Whole Body Contact Recreation

BTG—Boating and Canoeing

DWS—Drinking Water Supply

IND—Industrial Water Supply

Table 9.

STREAM NAME	COUNTY	C	MI	FROM	TO	BENEFICIAL USE
Blackberry Creek	Jasper	C	6.5	Mouth	T30N R33W S28	LWW, AQL
Browning Hollow	Lawrence	C	1	Mouth	T26N R26W S20	LWW, AQL
Buch Branch	Jasper	C	6	Mouth	T29N R31W S18	LWW, AQL
Capps Creek	Newton	P	4	Mouth	T25N R28W S17	IRR, LWW, AQL CDF, WBC, BTG,
Unnamed Trib to Capps Creek	Newton	P	1	Mouth	T25N R39W S14	LWW, AQL
Cave Spring Branch	Jasper	C	1	T28N R29W S16	T28N R29W S21	LWW, AQL
Center Creek	Jasper	P	29	T28N R34W S14	T28N R31W S34	IRR, LWW, AQL, CLF, WBC, BTG, IND
Center Creek	Jasper	P	22	T28N R31W S34	T27N R29W S23	IRR, LWW, AQL, WBC, BTG, IND
Center Creek	Newton	P	3	T27N R29W S23	T27N R28W S17	IRR, LWW, AQL, CDF, WBC, BTG, IND
Unnamed Trib to Center Cr	Newton	C	1	Mouth	T27N R29W S21	LWW, AQL, WBC

STREAM NAME	COUNTY	C	MI	FROM	TO	BENEFICIAL USE
Chaney Branch	Barton	C	3	Mouth	T32N R28W S 6	LWW, AQL
Clear Creek	Newton	P	9	Mouth	T26N R28W S28	LWW, AQL
Clear Creek	Lawrence	C	2		T26N R28W S28	LWW, AQL
Coon Creek	Barton	C	7	Mouth	T30N R30W S14	LWW, AQL
Coon Creek	Dade	C	8	Mouth	T29N R28W S 5	LWW, AQL
Dicks Fork	Barton	C	2	Mouth	T32N R31W S28	LWW, AQL
Douger Branch	Lawrence	C	4.5	Mouth	T26N R25W S 7	LWW, AQL
Dry Branch	Jasper	C	9	Mouth	T29N R30W S 8	LWW, AQL, WBC
Dry Fork	Lawrence	C	2	T28N R27W S 5	T29N R27W S29	LWW, AQL
Dry Hollow	Lawrence	C	0.5	T28N R28W S15	T28N R28W S22	LWW, AQL
Dry Valley Branch	Newton	P	1	Mouth	T27N R29W S26	LWW, AQL
Dry Valley Branch	Newton	C	2	T27N R29W S26	T27N R29W S25	LWW, AQL
Duval Creek	Jasper	C	7	Mouth	T30N R32W S13	LWW, AQL
Elm Spring Branch	Newton	C	1	T24N R31W S 6	T24N R31W S 7	LWW, AQL
Fidelity Creek	Jasper	P	1.5	Mouth	Alt Hwy 71	LWW, AQL
Five Mile Creek	Newton	P	5	State Line	T26N R33W S21	IRR, LWW, AQL
Glendale Fork	Barton	C	4	Mouth	T31N R33W S14	LWW, AQL
Grove Creek	Jasper	P	2	Mouth	T27N R32W S 1	LWW, AQL

STREAM NAME	COUNTY	C	MI	FROM	TO	BENEFICIAL USE
Hickory Creek	Newton	P	4.5	Mouth	T25N R31W S28	LWW, AQL, WBC
Honey Creek	Lawrence	P	13	Mouth	T27N R25W S22	LWW, AQL
Honey Creek	Lawrence	C	2	T27N R25W S22	T27N R25W S35	LWW, AQL
Horse Creek	Barton	C	25	T34N R29W S35	T31N R28W S15	LWW, AQL
Unnamed Trib to Horse Creek	Dade	C	2	Mouth	T32N R28W S29	LWW, AQL
Hudson Creek	Barry	C	4	T25N R28W S17	T25N R28W S11	LWW, AQL
Jacobs Branch	Newton	P	1	Mouth	T26N R33W S 2	LWW, AQL
Jenkins Creek	Jasper	P	4	Mouth	T27N R30W S 7	LWW, AQL, CDF
Jenkins Creek	Jasper	C	1.5	T27N R30W S 7	T27N R30W S27	LWW, AQL, CDF
Unnamed Trib to Jenkins Cr	Jasper	C	1.5	T27N R29W S 7	T27N R29W S19	LWW, AQL
Jones Creek	Jasper	P	7	Mouth	T27N R30W S30	LWW, AQL, CLF, WBC
Jordan Branch	Dade	C	1	Mouth	T30N R26W S13	LWW, AQL
Joyce Creek	Barry	C	5	Mouth	T24N R28W S16	LWW, AQL
Kyle Creek	Barton	C	8	T31N R29W S23	T31N R28W S35	LWW, AQL
Little Coon Creek	Barton	C	4	Mouth	T30N R29W S 6	LWW, AQL
Little N Fork Spring River	Jasper	C	13	Mouth	T31N R32W S30	IRR, LWW, AQL

STREAM NAME	COUNTY	C	MI	FROM	TO	BENEFICIAL USE
Trib to Little North Fork	Barton	C	1	Mouth	T31N R32W S29	LWW, AQL
North Fork Spring River	Jasper	C	14.5	Mouth	T29N R32W S 1	LWW, AQL, WBC
North Fork Spring River	Jasper	C	51.5	T29N R32W S 1	T30N R28W S20	LWW, AQL
Trib to North Fk Spring R	Barton	C	13	Mouth	T33N R30W S31	LWW, AQL
Newtonia Branch	Newton	P	1	Mouth	T26N R30W S36	LWW, AQL
Opossum Creek	Jasper	C	6	Mouth	T30N R30W S28	LWW, AQL
Pettis Creek	Barton	C	6.5	Mouth	T31N R30W S 9	LWW, AQL
Pogue Creek	Barry	C	2.5	Mouth	T24N R28W S32	LWW, AQL
Pond Creek	Jasper	C	3	Mouth	T30N R33W S30	LWW, AQL
Shoal Creek	Newton	P	43.5	State Line	T25N R29W S10	IRR, LWW, AQL, CLF, WBC, BTG, DWS IND
Shoal Creek	Newton	P	0.5	T25N R29W S10	Capps Creek	IRR, LWW, AQL, CDF, WBC, BTG
Shoal Creek	Newton	P	13.5	Capps Creek	T23N R28W S12	IRR, LWW, AQL, CLF, WBC, BTG
Shoal Creek	Barry	C	4	T23N R28W S12	Hwy 86	LWW, AQL
Unnamed Trib to Shoal Creek	Newton	P	1	Mouth	T26N R32W S10	LWW, AQL

STREAM NAME	COUNTY	C	MI	FROM	TO	BENEFICIAL USE
Silver Creek	Newton	P	2.5	Mouth	T27N R33W S25	LWW, AQL
Slater Branch	Jasper	C	3	Mouth	T30N R32W S34	LWW, AQL
Spring River	Jasper	P	0.5	T28N R34W S22	T28N R34W S15	IRR, LWW, AQL, CLF, WBC, BTG, IND
Spring River	Jasper	P	58.5	State Line	T28N R27W S20	IRR, LWW, AQL, CLF, WBC, BTG, IND
Spring River	Lawrence	P	9.5	T28N R27W S20	T27N R27W S13	IRR, LWW, AQL, CDF, WBC, BTG, IND
Spring River	Lawrence	P	10	T27N R27W S13	T26N R26W S28	LWW, AQL, WBC, BTG
Spring River	Lawrence	C	1	T26N R26W S28	T26N R26W S27	LWW, AQL
Unnamed Trib to Spring R	Lawrence	P	3	Mouth	T28N R28W S 5	LWW, AQL
Unnamed Trib to Spring R	Jasper	C	3.5	Mouth	T29N R33W S23	LWW, AQL
Unnamed Trib to Spring R	Lawrence	C	1	Mouth	T28N R28W S12	LWW, AQL
Unnamed Trib to Spring R	Lawrence	C	1	T28N R28W S16	T28N R28W S15	LWW, AQL
Stahl Creek	Lawrence	P	6.5	Mouth	T29N R27W S25	LWW, AQL
Unnamed Trib to Stahl Creek	Lawrence	C	2	Mouth	T29N R27W S22	LWW, AQL
Thurman Creek	Newton	P	2.5	Mouth	T27N R32W S30	LWW, AQL

STREAM NAME	COUNTY	C	MI	FROM	TO	BENEFICIAL USE
Truitt Creek	Lawrence	P	1.5	T28N R27W S23	T28N R27W S23	LWW, AQL
Truitt Creek	Lawrence	C	5	Mouth	T28N R33W S35	LWW, AQL
Turkey Creek	Jasper	P	7	State Line	T27N R32W S 9	LWW, AQL, WBC
Turkey Creek	Jasper	P	5	T28N R33W S35	T31N R31W S 8	LWW, AQL
West Fork	Barton	C	5	Mouth	T31N R31W S 8	LWW, AQL
White Oak Creek	Jasper	C	15	Mouth	Hwy 97	IRR, LWW, AQL, WBC
Unnamed Trib to White Oak Creek	Lawrence	C	5	Mouth	Hwy 97	LWW, AQL
Williams Creek	Lawrence	P	1	Mouth	T28N R27W S28	LWW, AQL, CDF, WBC
Williams Creek	Lawrence	P	7	T28N R27W S28	T28N R26W S34	LWW, AQL, WBC
Williams Creek	Lawrence	C	1.5	T28N R26W S34	T28N R26W S35	LWW, AQL

AQL—Protection of Warm Water Aquatic Life and Human Health- Fish Consumption CLF—Cool Water Fishery

CDF—Cold Water Fishery

WBC—Whole Body Contact Recreation BTG—Boating and Canoeing

DWS—Drinking Water Supply IND—Industrial Water Supply

Source: Missouri Department of Natural Resources (1996). LWW—Livestock and Wildlife Watering

AQL—Protection of Warm Water Aquatic Life and Human Health- Fish Consumption

CLF—Cool Water Fishery CDF—Cold Water Fishery

WBC—Whole Body Contact Recreation BTG—Boating and Canoeing

DWS—Drinking Water Supply IND—Industrial Water Supply

Table 10. Chemical water quality summary for the Spring River Basin.

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Spring River near Waco				
Discharge	271	17, 300	36	970
Specific conductance	271	544	92	317
pH	106	8.6	6.8	—
Temperature	262	30.5	0	14.9
Dissolved oxygen	269	17.6	2	8.8
Suspended solids	26	280	1	38
Fecal coliform	62	15, 000	2	950
Calcium	247	73	14	53
Magnesium	247	10	0.9	3.8
Sodium	248	16	1.7	7.2
Potassium	248	7.1	0.9	2.6
Alkalinity	258	196	24	121
Sulfate	247	110	6.5	23
Chloride	172	21	2.3	10
Fluoride	122	1.2	—	0.17
Total nitrite plus nitrate	139	3	0.1	1.7
Total ammonia	129	3.1	—	0.12
Dissolved ammonia	31	1.8	0	0.08
Total phosphorus	165	1.3	0.02	0.21
Dissolved phosphorus	35	0.6	0	0.12
Total-recoverable cadmium	20	30	—	0.12
Dissolved cadmium	21	5	—	3.76
Dissolved chromium	32	39	—	8.07
Total-recoverable	20	13	—	5.34

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
copper				
Dissolved copper	50	160	—	14
Total-recoverable iron	20	8, 000	4	1300
Dissolved iron	53	300	—	50.06
Total-recoverable lead	17	52	—	13.78
Dissolved lead	72	80	—	8.77
Total-recoverable manganese	19	170	20	83
Total-recoverable zinc	19	470	—	132.63
Dissolved zinc	82	2, 400	0	90
Cow Creek near Weir, Kansas				
Discharge	101	9, 350	2.6	738
Specific conductance	92	1, 620	135	856
pH	69	8.6	6.4	—
Temperature	82	30	0	14.3
Dissolved oxygen	46	12.8	1	6.4
Suspended solids	—	—	—	—
Fecal coliform	—	—	—	—
Calcium	38	160	18	83
Magnesium	38	81	6	42
Sodium	35	110	5.8	60
Potassium	35	14	3.1	7.5
Alkalinity	38	189	14	79
Sulfate	40	720	70	380
Chloride	40	96	4	38
Fluoride	39	1	0.2	0.6
Total nitrite plus	—	—	—	—

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
nitrate				
Total ammonia	32	13	0.19	3.3
Dissolved ammonia	17	11	0.28	3.2
Total phosphorus	31	7.6	0.02	1.1
Dissolved phosphorus	—	—	—	—
Total-recoverable cadmium	—	—	—	—
Dissolved cadmium	—	—	—	—
Dissolved chromium	—	—	—	—
Total-recoverable copper	49	40	—	12.17
Dissolved copper	48	20	—	10.68
Total-recoverable iron	49	16, 000	360	3200
Dissolved iron	48	1, 300	—	138.68
Total-recoverable lead	44	320	—	35.3
Dissolved lead	30	80	—	14.46
Total-recoverable manganese	49	7, 000	310	2800
Total-recoverable zinc	49	370	—	103.38
Dissolved zinc	48	170	—	40.33
Brush Creek near Weir, Kansas				
Discharge	38	153	0.12	16
Specific conductance	38	1, 650	525	1080
pH	36	6.9	3.1	—
Temperature	38	26.5	0	14.3
Dissolved oxygen	33	12.8	3.5	8.1

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Suspended solids	—	—	—	—
Fecal coliform	—	—	—	—
Calcium	34	170	52	100
Magnesium	34	68	20	46
Sodium	31	67	16	46
Potassium	31	10	3.8	6
Alkalinity	35	42	—	9.06
Sulfate	35	840	200	550
Chloride	34	16	8	11
Fluoride	34	0.9	0.2	0.6
Total nitrite plus nitrate	1	0.7	—	—
Total ammonia	30	1.4	0.18	0.8
Dissolved ammonia	16	1.6	0.25	0.81
Total phosphorus	27	0.13	—	0.04
Dissolved phosphorus	—	—	—	—
Total-recoverable cadmium	—	—	—	—
Dissolved cadmium	—	—	—	—
Dissolved chromium	—	—	—	—
Total-recoverable copper	—	—	—	—
Dissolved copper	—	—	—	—
Total-recoverable iron	35	14, 000	890	4100
Dissolved iron	36	14, 000	10	3000
Total-recoverable lead	30	120	—	30.22
Dissolved lead	25	98	—	15.36

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Total-recoverable manganese	36	7, 200	910	3800
Total-recoverable zinc	36	800	30	260
Dissolved zinc	35	820	20	260
Center Creek near Carterville				
Discharge	294	4, 910	16	226
Specific conductance	294	910	111	385
pH	294	8.6	4.8	—
Temperature	294	29.5	0	15.4
Dissolved oxygen	278	15	3.8	8.4
Suspended solids	102	921	1	27
Fecal coliform	191	29, 000	1	800
Calcium	191	110	17	58
Magnesium	190	15	0.7	3.7
Sodium	198	29	2.1	10
Potassium	192	4.6	0.2	1.8
Alkalinity	234	141	8	110
Sulfate	200	210	6	43
Chloride	200	28	2.3	9.6
Fluoride	199	40	0	6.1
Total nitrite plus nitrate	134	30	0.1	6
Total ammonia	157	22	0.01	1.9
Dissolved ammonia	56	8.5	0	2.2
Total phosphorus	183	3	0.02	0.27
Dissolved phosphorus	81	2.2	0	0.28
Total-recoverable cadmium	38	55	—	2.67

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Dissolved cadmium	43	31	—	1.81
Dissolved chromium	75	60	—	11.32
Total-recoverable copper	38	14	—	5.84
Dissolved copper	109	270	—	21.92
Total-recoverable iron	37	4, 300	10	530
Dissolved iron	107	360	—	37.95
Total-recoverable lead	50	730	—	27.09
Dissolved lead	149	390	—	12.22
Total-recoverable manganese	38	420	10	86
Total-recoverable zinc	50	610	20	89
Dissolved zinc	164	2, 500	0	180
Center Creek near Smithfield				
Discharge	309	7, 540	18	313
Specific conductance	337	868	123	423
pH	172	8.6	6.6	—
Temperature	324	30	0	15.3
Dissolved oxygen	335	15.7	3.6	9.4
Suspended solids	121	328	1	16
Fecal coliform	158	11, 000	2	450
Calcium	251	120	24	73
Magnesium	251	11	1.1	3.6
Sodium	251	33	2.2	9.5
Potassium	250	5.2	0.8	1.9
Alkalinity	339	168	26	113

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Sulfate	250	250	5	67
Chloride	175	26	3.3	10
Fluoride	123	21	0	1.2
Total nitrite plus nitrate	236	22	0.2	5.7
Total ammonia	223	9.6	—	0.31
Dissolved ammonia	22	16	0	2.1
Total phosphorus	216	1.4	0.01	0.19
Dissolved phosphorus	35	1.3	0.04	0.24
Total-recoverable cadmium	52	92	—	5.85
Dissolved cadmium	54	10	—	1.89
Dissolved chromium	30	30	—	7.31
Total-recoverable copper	51	21	—	6.14
Dissolved copper	83	190	—	11.84
Total-recoverable iron	52	4, 200	60	550
Dissolved iron	86	730	—	37.82
Total-recoverable lead	52	270	—	23.14
Dissolved lead	90	130	—	7.37
Total-recoverable manganese	50	800	20	89
Total-recoverable zinc	51	1, 400	50	500
Dissolved zinc	94	1, 900	7	480
Turkey Creek near Joplin				
Discharge	330	955	3	42
Specific conductance	360	1, 190	226	611

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
pH	193	8.5	6.7	—
Temperature	351	33	1	15.6
Dissolved oxygen	355	16.7	0.3	5.8
Suspended solids	34	55	1	11
Fecal coliform	115	1, 000, 000	2	22, 000
Calcium	311	130	32	92
Magnesium	311	13	1	6
Sodium	311	65	4.7	27
Potassium	311	20	1.9	6.6
Alkalinity	313	222	54	151
Sulfate	338	220	27	120
Chloride	260	110	4.4	29
Fluoride	183	4	0	0.4
Total nitrite plus nitrate	148	7.8	0.1	1.8
Total ammonia	163	13	0	2.2
Dissolved ammonia	44	5.2	—	1.43
Total phosphorus	201	8.3	0.08	1.7
Dissolved phosphorus	70	6.6	0.15	1.6
Total-recoverable cadmium	1	7	—	—
Dissolved cadmium	—	—	—	—
Dissolved chromium	70	130	—	9.66
Total-recoverable copper	1	11	—	—
Dissolved copper	66	190	—	26.37
Total-recoverable iron	1	410	—	—
Dissolved iron	70	330	—	98.03

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Total-recoverable lead	2	27	12	—
Dissolved lead	99	350	—	14.5
Total-recoverable manganese	1	110	—	—
Total-recoverable zinc	2	620	240	—
Dissolved zinc	112	1, 300	0	440
Short Creek at Galena, Kansas				
Discharge	14	800	0.98	70
Specific conductance	13	1, 570	180	927
pH	13	7.2	5	—
Temperature	13	34	6	20.2
Dissolved oxygen	8	12.2	8.4	10.2
Suspended solids	—	—	—	—
Fecal coliform	—	—	—	—
Calcium	12	260	17	140
Magnesium	12	81	1.3	21
Sodium	11	27	3	17
Potassium	11	16	2	9.4
Alkalinity	14	44	4	17
Sulfate	14	830	43	420
Chloride	14	32	4	19
Fluoride	8	6	0.2	3.3
Total nitrite plus nitrate	—	—	—	—
Total ammonia	9	34	—	16.69
Dissolved ammonia	3	21	0.19	—
Total phosphorus	10	100	3.6	46
Dissolved	10	100	3.6	46

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
phosphorus				
Total-recoverable cadmium	—	—	—	—
Dissolved cadmium	—	—	—	—
Dissolved chromium	—	—	—	—
Total-recoverable copper	—	—	—	—
Dissolved copper	13	6, 500	20	1, 200
Total-recoverable iron	14	5, 100	40	1, 300
Dissolved iron	13	170	—	45.34
Total-recoverable lead	14	24, 000	—	3, 537.78
Dissolved lead	—	—	—	—
Total-recoverable manganese	14	4, 900	620	2, 400
Total-recoverable zinc	14	200, 000	6, 900	87, 000
Dissolved zinc	13	200, 000	1, 800	85, 000
Shoal Creek near Galena, Kansas				
Discharge	181	3, 860	45	454
Specific conductance	212	340	126	278
pH	45	8.9	7.4	—
Temperature	202	30	0	15.6
Dissolved oxygen	210	14	1.1	9.6
Suspended solids	—	—	—	—
Fecal coliform	32	29, 000	1	1, 000
Calcium	211	63	22	49
Magnesium	211	40	0.9	3.1
Sodium	211	10	1.8	5.6

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Potassium	211	6.4	0.9	1.8
Alkalinity	211	174	45	119
Sulfate	211	50	—	11.28
Chloride	135	15	2.1	8.7
Fluoride	81	0.4	—	0.12
Total nitrite plus nitrate	116	3	0.1	1.7
Total ammonia	112	0.3	—	0.05
Dissolved ammonia	23	0.1	—	0.02
Total phosphorus	—	—	—	—
Dissolved phosphorus	1	50	—	—
Total-recoverable cadmium	14	930	30	490
Dissolved cadmium	12	900	—	426.81
Dissolved chromium	—	—	—	—
Total-recoverable copper	14	6, 700	60	1, 400
Dissolved copper	—	—	—	—
Total-recoverable iron	7	240	90	160
Dissolved iron	41	70	—	23.9
Total-recoverable lead	—	—	—	—
Dissolved lead	—	—	—	—
Total-recoverable manganese	11	60	—	27.74
Total-recoverable zinc	7	300	60	110
Dissolved zinc	6	110	40	53
Spring River near Baxter Springs, Kansas				

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Discharge	283	29, 400	69	1, 950
Specific conductance	353	610	120	372
pH	200	8.5	6.6	—
Temperature	308	32.5	0	16.4
Dissolved oxygen	243	14.3	4.2	8.9
Suspended solids	35	227	3	40
Fecal coliform	52	11, 000	1	780
Calcium	318	83	13	57
Magnesium	320	17	1.7	5.8
Sodium	319	27	3.1	10
Potassium	317	6	1.1	2.7
Alkalinity	350	164	24	103
Sulfate	350	170	17	60
Chloride	289	48	3.7	12
Fluoride	190	5.2	0	0.8
Total nitrite plus nitrate	116	8.9	0.1	2.6
Total ammonia	112	2.2	—	0.23
Dissolved ammonia	25	1.7	0	0.48
Total phosphorus	192	1.3	0.01	0.37
Dissolved phosphorus	34	0.9	0.01	0.33
Total-recoverable cadmium	0	0	0	0
Dissolved cadmium	0	0	0	0
Dissolved chromium	0	0	0	0
Total-recoverable copper	0	0	0	
Dissolved copper	0	0	0	0

PROPERTY	NUMBER OF SAMPLES	MAXIMUM	MINIMUM	MEAN
Total-recoverable iron	15	660	10	180
Dissolved iron	73	1, 600	0	76
Total-recoverable lead	0	0	0	0
Dissolved lead	0	0	0	0
Total-recoverable manganese	23	260	0	130
Total-recoverable zinc	3	350	200	0
Dissolved zinc	6	610	80	310

Source: Davis and Schumacher (1992).

Table 11. Fish kill summary for the Spring River Basin from 1979-1995.

DATE	STREAM	COUNTY	NUMBER KILLED	ESTIMATED VALUE	CAUSE/SOURCE
8/23/94	North Fk Spring River	Barton	N/A	N/A	Industrial waste
7/1/94	Trib to Shoal Creek	Newton	N/A	N/A	Aquashade
4/20/94	Thruman Creek	Newton	28, 675	4, 677.92	Dursban
9/29/94	Spring Br/Cedar Cr	Newton	8, 000	3, 360.00	Bentonite
12/3/93	Trib to Pettis Creek	Barton	N/A	N/A	Toxins
6/16/93	Trib to Grove Creek	Jasper	N/A	N/A	Indus
11/30/93	Grove Creek	Jasper	592	111.62	Anhydrous ammonia
5/21/93	Shoal Creek	Newton	N/A	N/A	Municipal
2/23/93	Motley Branch	Newton	4, 438	1, 311.00	Diesel fuel
8/10/92	Capps Creek	Barry	N/A	N/A	N/A
5/22/92	Clear Creek	Barton	N/A	N/A	Hog manure
2/11/92	Grove and Center Cr	Jasper	29, 125	2, 389.79	Ammonium hydroxide
9/18/92	Joplin Creek	Jasper	N/A	N/A	Asphalt sealer
4/8/92	Williams Creek	Lawrence	N/A	N/A	Sewage effluent
8/14/92	Kelly Creek	Barry	N/A	N/A	Poultry Process Water
7/26/91	Clear Creek	Barry	N/A	N/A	Ammonia
1/6/91	Lone Elm Creek	Jasper	N/A	N/A	Potassium hydroxide
2/28/91	Grove Creek	Jasper	3, 596	288.62	Hydrochloric acid
6/21/91	Grove and Center Cr	Jasper	30, 059	2, 487.33	Urea ammonia
8/14/91	Grove Creek	Jasper	5, 698	488.76	Urea ammonia
9/26/91	Trib to Blackberry Cr	Jasper	N/A	N/A	Acid mine drainage

DATE	STREAM	COUNTY	NUMBER KILLED	ESTIMATED VALUE	CAUSE/SOURCE
12/15/91	Trib to Silver Cr	Jasper	N/A	N/A	Sewage
8/5/91	Newtonia Branch	Newton	N/A	N/A	Aquatic habitat destru
6/10/90	Dicks Fork	Barton	67	N/A	Fertilizer
5/16/90	Lamar City Lake	Barton	200+	68	Spawning stress
6/15/90	Stony Branch	Jasper	4, 096	592.62	Pipeline break
1/30/90	Turkey Creek	Jasper	N/A	N/A	Truck spill
6/29/89	North Fk Spring River	Dade	N/A	N/A	Truck spill
5/7/89	Silver Creek	Jasper	4, 334	448.63	Ammonia
3/22/89	Grove Creek	Jasper	N/A	N/A	Acid
4/8/89	Grove Creek	Jasper	46	N/A	Sulfuric acid
4/17/89	Blackberry Creek	Jasper	N/A	N/A	Power
11/20/89	Grove Creek	Jasper	400	32	Chemical spill
2/1/88	Grove Creek	Jasper	5, 000	N/A	Chemical spill
2/18/88	Grove Creek	Jasper	N/A	N/A	Chemical spill
4/4/88	Grove Creek	Jasper	7, 148	435.65	Chemical spill
7/12/88	Grove Creek	Jasper	5, 592	374.85	Chemical spill
12/7/88	Grove Creek	Jasper	30	N/A	Chemical spill
7/1/88	Turkey Creek	Jasper	N/A	N/A	Petroleum
6/22/88	Williams Creek	Lawrence	976	158.54	Sewage
1/26/87	Trib N Fk Spring R	Jasper	N/A	N/A	Truck spill
4/28/87	Grove Creek	Jasper	344	23.64	Industrial
11/20/87	Grove Creek	Jasper	165	9.9	Chemical spill
Jul-87	Williams Creek	Lawrence	6, 098	988.59	Sewage
7/20/87	Stahl Creek	Lawrence	N/A	N/A	Sewage
7- 8-11-87	Stahl Creek	Lawrence	N/A	N/A	Sewage

DATE	STREAM	COUNTY	NUMBER KILLED	ESTIMATED VALUE	CAUSE/SOURCE
11/30/87	Trib to Cedar Creek	Newton	N/A	N/A	Pipeline break
2/12/86	Clear Creek	Barry	6, 888	451.87	Sewage
Jun-86	Turkey Creek	Jasper	4, 855	1, 522.00	Sewage
6/30/86	Center Creek	Jasper	N/A	N/A	Chemical spill
9/12/86	Possum Creek	Jasper	<200	N/A	Sewage
12/22/86	Grove Creek	Jasper	N/A	N/A	Chemical spill
10/13/86	Grove Creek	Jasper	3, 874	255.39	Chemical spill
8/14/86	Williams Creek	Lawrence	932	173.94	Sewage
12/19/86	Stahl Cr/Spring River	Lawrence	N/A	N/A	Sewage
8/25/86	Honey Creek	Lawrence	1, 442	251.97	Sewage
4/12/85	Hudson/Capps Creek	Barry	N/A	N/A	Sewage
4/12/85	Trib to Shoal Creek	Barry	N/A	N/A	Agricultural manure
2/22/85	Trib L N Fk Spring R	Barton	N/A	N/A	Petroleum
11/11/85	Trib to Center Creek	Jasper	N/A	N/A	Chemical spill
4/25/85	Williams Creek	Lawrence	N/A	N/A	Food spill
11/18/85	Shoal Creek	Newton	N/A	N/A	Railway spill
1/20/84	Williams Creek	Lawrence	853	N/A	Ammonia
6/16/83	Center Creek	Jasper	N/A	N/A	Kerosene
8/18/83	Turkey Creek	Jasper	N/A	N/A	Sewage
2/12/82	Center Creek	Jasper	N/A	N/A	Acid/Alkali spill
8/3/82	Trib to Center Creek	Jasper	N/A	N/A	Sulfuric acid
8/13/82	Silver Creek	Newton	N/A	N/A	Lindane
7/15/81	Trib to N Fk Spring R	Barton	N/A	N/A	Animal fat spill

DATE	STREAM	COUNTY	NUMBER KILLED	ESTIMATED VALUE	CAUSE/SOURCE
7/21/81	Turkey Creek	Jasper	N/A	N/A	Heavy metal
4/21/81	Williams Creek	Lawrence	N/A	N/A	Sewage
11/14/81	Spring River	Lawrence	N/A	N/A	Dioxin
2/12/80	Shoal Creek	Newton	N/A	N/A	Diseal fuel
4/10/79	Trib to N Fk Spring R	Barton	N/A	N/A	Landfill leachate
6/24/79	Muddy Creek	Barton	N/A	N/A	Agriculture biproduct
8/23/79	Short Creek	Barton	N/A	N/A	Ammonia phosphate
8/27/79	Spring River	Lawrence	N/A	N/A	Oil spill
3/7/79	Shoal Creek	Newton	N/A	N/A	Demolition material
4/29/79	White Oak Creek	Lawrence	2, 874	562.5	Hog waste
5/17/79	North Fk Spring River	Barton	40, 205	15, 735.00	Ammonia
7/14/79	Turkey Creek	Jasper	444	51.58	Sewage

Source: Missouri Department of Conservation Fish Kill Summary (1996).

Table 12. Permitted point sources in the Spring River Basin.

FACILITY NAME	RECEIVING STREAM	LOCATION (T R S)	COUNTY
MONETT WWTF	CLEAR CREEK	SE, SE 26N 28W 36	BARRY
PURDY WASTE LAGOON	SOUTH FORK CAPPS CR	SW, SW 24N 28W 2	BARRY
ANGEL EST AND COURTESY CT	MUDDY CR/N FK SPRING RIVER	NE, SW 32N 31W 24	BARTON
BLUE TOP MOTEL AND CAFE	N FORK SPRING RIVER	NE, SE 32N 31W 26	BARTON
GOLDEN CITY WWTF	TRIB TO N FK SPRING R	NW, SW 31N 29W 26	BARTON
LAMAR WWTF	N FORK SPRING RIVER	N, NE 32N 31W 36	BARTON
LAMAR WWTP	TRIB TO N FK SPRING R	NE, NE 32N 30W 31	BARTON
MACKIE CLEMENS FUEL CO	BLACKBERRY CREEK	SE, SW 30N 33W 8	BARTON
MINDEN ACRES	ABANDONED STRIP MINE	NE 31N 33W 6	BARTON
ALBA WWTP	TRIB TO BUCK BRANCH	NE, NW 29N 32W 15	JASPER
BUTTERBALL TURKEY CO	SPRING RIVER	SW, SW 29N 31W 34	JASPER
CARTHAGE WWTF	SPRING RIVER	NW, NE 28N 31W 5	JASPER
CARL JUNCTION WWTF	CENTER CREEK	SW, NW 28N 33W 8	JASPER
CENTERVILLE LIFT STATION	TRIB TO CENTER CREEK	S 28N 33W 1	JASPER
DOSKOCIL SPECIALTY BRANDS	TRIB TO CENTER CREEK	NW, SE 28N 31W 33	JASPER
EAGLE-PICHER INDUSTRIES	ELM CREEK	NW, NW 27N 33W 3	JASPER
EMPIRE, ASBURY	BLACKBERRY CREEK	NE, NW 30N 33W 17	JASPER
EMPIRE, ASBURY	BLACKBERRY CREEK	NE, NW 30N 33W 17	JASPER
FAIRVIEW GREENHOUSE INC	TRIB TO SPRING RIVER	SE, NE 28N 31W 10	JASPER
FARMERS CHEMICAL CO	SHORT CREEK	SW, NW 27N 34W 2	JASPER
FIBREX INC, JOPLIN PLANT	TRIB TO LONE ELM HOL	NW, NW 27N 33W 3	JASPER

FACILITY NAME	RECEIVING STREAM	LOCATION (T R S)	COUNTY
FIBREX INC, JOPLIN PLANT	TRIB TO LONE ELM HOL	NW, NW 27N 33W 3	JASPER
FOUNTAIN ROAD PARK VILLAGE	TRIB TO CENTER CREEK	NE, NW 28N 32W 26	JASPER
HICKORY LANE MHP	TRIB TO GROVE CREEK	SE, NW 27N 32W 13	JASPER
ICI EXPLOSIVES USA INC	GROVE CREEK	W 28N 32W 36	JASPER
ICI EXPLOSIVES USA INC	GROVE CREEK	W 28N 32W 36	JASPER
ICI EXPLOSIVES USA INC	GROVE CREEK	W 28N 32W 36	JASPER
ICI EXPLOSIVES ENVIRONMENTAL	GROVE CREEK	NW 28N 32W 36	JASPER
INLAND PRODUCTS INC	SPRING RIVER	SE, SE 29N 31W 33	JASPER
IRECO INC	CENTER CREEK	SE, NW 28N 32W 13	JASPER
IRECO INC	CENTER CREEK	SE, NW 28N 32W 13	JASPER
JASPER WWTF	TRIB TO OPOSSUM CREEK	NW, SE 30N 31W 23	JASPER
JOPLIN, TURKEY CREEK WWTP	TURKEY CREEK	SE 28N 33W 29	JASPER
SARCOXIE WWTF	CENTER CREEK	NE, NE 27N 29W 8	JASPER

Table 13. Permitted stormwater discharges in the Spring River Basin

FACILITY NAME	RECEIVING STREAM	LOCATION (T R S)	COUNTY
CHEVRON EMPIRE MINE	BLACKBERRY CREEK	31N 33W 23	BARTON
LAMAR CLOSED LANDFILL	TRIB TO DICKS FORK	NW, SW 32N 31W 35	BARTON
MIDWEST MINERALS LIMESTONE	LITTLE COON CREEK	SE, SW 30N 30W 9	BARTON
ANCHOR STONE JASPER QUARRY	GROVE CREEK	NW, SE 28N 32W 34	JASPER
CARTHAGE CRUSHED LIMESTONE	SPRING RIVER	SE, NW 29N 31W 33	JASPER
CARTHAGE CRUSHED LIMESTONE	SPRING RIVER	SW, NE 28N 31W 33	JASPER
CARTHAGE DEMOLITION LANDFILL	TRIB TO SPRING RIVER	NW, NE 28N 31W 8	JASPER
CHEVRON EMPIRE MINE	BLACKBERRY CREEK		JASPER
INTERNATIONAL PAPER	JOPLIN CREEK	NW 27N 32W 18	JASPER
JOPLIN STONE CO	TRIB TO CENTER CREEK	SE, NE 28N 32W 27	JASPER
JOPLIN SANITARY LANDFILL	TRIB TO TURKEY CREEK	SW, NE 28N 33W 32	JASPER
LEGGET AND PLATT WIRE MILL	TRIB TO SPRING RIVER	SW, NE 28N 31W 3	JASPER
MISSOURI STEEL CASTINGS	TRIB TO TURKEY CREEK	NE, SW 27N 33W 2	JASPER
TAMKO ASPHALT PLANT 2	TURKEY CREEK	SW, SW 28N 32W 31	JASPER
TATE'S TRANSFER STATION	TRIB TO HONEY CREEK	NE, SE 27N 26W 19	LAWRENCE
FULLERTON STONE	TRIB TO SHOAL CREEK	W, NW 25N 29W 17	NEWTON
KCSRC NEOSHO YARD MECH	TRIB TO HICKORY CREEK	NE, SW 25N 31W 19	NEWTON

FACILITY NAME	RECEIVING STREAM	LOCATION (T R S)	COUNTY
SAGINAW QUARRIES	TRIB TO THURMAN CREEK	NE, SW 27N 32W 28	NEWTON
SOUTHWEST LIME QUARRY	SHOAL CREEK	N, SW 25N 32W 7	NEWTON
WNGC SAGINAW COMP STATION	THURMAN CREEK	SE, SE 27N 33W 36	NEWTON
TAMKO ASPHALT PRODUCTS	TURKEY CREEK	SE, SE 28N 33W 35	JASPER
TAMKO ASPHALT PRODUCTS	TURKEY CREEK	SE, SE 28N 33W 35	JASPER
VICKERS INCORPORATED	SHORT CREEK	E, NE 27N 33W 8	JASPER
VICKERS INCORPORATED	TRIB TO TURKEY CREEK	E, NE 27N 33W 8	JASPER
AURORA WWTP	CHAT CREEK/DOUGER BR	SE, NW 26N 26W 11	LAWRENCE
CONOCO, MT VERNON	TRIB TO TRUITT CREEK	SW, SW 29N 26W 28	LAWRENCE
FREISTATT WWTF	TRIB TO SPRING RIVER	SW, NE 27N 27W 29	LAWRENCE
MARIONVILLE WWTF	HONEY CREEK	NE, NE 27N 25W 27	LAWRENCE
MILLER WWTF	TRIB TO STAHL CREEK	NE, SW 29N 27W 23	LAWRENCE
MT VERNON WWTF	WILLIAMS CREEK	NE, SE 28N 27W 25	LAWRENCE
NICKERSON FARMS	TRIB TO DRY HOLLOW CR	SW, SW 27N 28W 1	LAWRENCE
PIERCE CITY WWTP	CLEAR CREEK	NW, SE 26N 28W 29	LAWRENCE
STOTTS CITY WWTF	DRY HOLLOW CREEK	SW, SE 28N 28W 26	LAWRENCE
SYNTEX AGRIBUSINESS INC	SPRING RIVER	SE, NW 26N 26W 17	LAWRENCE
SYNTEX AGRIBUSINESS INC	SPRING RIVER	SE, NW 26N 26W 17	LAWRENCE

FACILITY NAME	RECEIVING STREAM	LOCATION (T R S)	COUNTY
TRUCKSTOPS OF AMERICA	TRIB TO WILLIAMS CR	SE, NE 28N 26W 31	LAWRENCE
VERONA WWTF	SPRING RIVER	NW, NE 26N 26W 17	LAWRENCE
BLENDVILLE FILTER PLANT	SHOAL CREEK	NE, NE 27N 33W 15	NEWTON
DIAMOND MUNICIPAL WWTF	CARVER BRANCH	NE, NW 26N 31W 9	NEWTON
FAG BEARING CORP	SILVER CREEK	NW, SW 27N 32W 19	NEWTON
GRANBY WWTP	CULPEPPER BRANCH	SW, NW 26N 30W 31	NEWTON
JESSE'S TRUCK STOP	ROCK BRANCH	NE, SE 26N 33W 5	NEWTON
JOPLIN, SHOAL CREEK WWTF	SHOAL CREEK	SE, NE 27N 34W 25	NEWTON
JOPLIN TRANSPORT CENTER	ROCK BRANCH	SE, NE 26N 33W 5	NEWTON
LOMA LINDA ESTATES	ROCK BRANCH	SE, NE 26N 34W 12	NEWTON
MHTD, I-44 REST AREA	TRIB TO SHOAL CREEK	NW, SW 26N 33W 6	NEWTON
MISSOURI-NEBRASKA EXPRESS	SPRING CREEK	NE, NW 26N 33W 9	NEWTON
NEOSHO WTP	HICKORY CREEK	N, NW 25N 31W 18	NEWTON
NEOSHO, SHOAL CREEK WWTP	SHOAL CREEK	SE, SE 25N 32W 12	NEWTON
PILOT TRAVEL CENTER	TRIB TO ROCK BRANCH	NE, SE 26N 33W 5	NEWTON
PRONTO TRAVEL PLAZA	TRIB TO ROCK BRANCH	SW, NW 26N 33W 4	NEWTON
PRONTO TRAVEL PLAZA	TRIB TO ROCK BRANCH	SW, NW 26N 33W 4	NEWTON
SABRELINER CORP	TRIB TO HICKORY CREEK	NW, NW 24N 31W 30	NEWTON

FACILITY NAME	RECEIVING STREAM	LOCATION (T R S)	COUNTY
SHELL DIAMOND STATION	TRIB TO BAYNHAM BR	SE, NE 26N 31W 15	NEWTON
TALBOT INDUSTRIES PLANT II	TRIB TO ELM SPRING BR	SE 24N 32W 1	NEWTON TALBOT
INDUSTRIES PLANT I	WEST HIGH SCHOOL BR	SE, SW 25N 32W 24	NEWTON
USFWS NEOSHO FISH HATCHERY	HICKORY CREEK	NW, NE 24N 31W 30	NEWTON
WINTER HAVEN MHP	SPRING CREEK	SE, NW 26N 33W 4	NEWTON

Source: MDNR (1996b).

Habitat Conditions

Aquatic Community Classifications

Pflieger (1989) classified the streams of the Spring River Basin in the Ozark-Neosho and Prairie-Neosho divisions. The following information is based on his descriptions. Additional details are available in Pflieger (1989).

The Ozark Faunal Region lies primarily within the Ozark Plateaus Physiographic Province. This area is characterized by Mississippian or older bedrock consisting primarily of limestones and dolomites.

Streams of the Ozark Faunal Region are typically clear, have high gradients, and contain substrates comprised primarily of coarse gravel, rubble, boulders, and bedrock. Along the northern and western boundaries of this region, streams are typically transitional with those of the Prairie Faunal Region.

The Ozark-Neosho Division includes the entire Spring River Basin except the northern tributaries of the Spring River from (and including) the North Fork of the Spring River to the Kansas state line to the west. The headwaters of Dry Fork are included in the Ozark-Neosho Division.

Both local relief and stream gradient are generally less in the Ozark-Neosho Division than those of associated Ozark divisions. Streams within this division are typically transitional with those of the adjacent Prairie Faunal Region. The numerous springs found within this division are mostly small.

The Prairie Faunal Region covers most of Missouri north of the Missouri River and an area south of the Missouri River along the Kansas state line. This region is largely co-extensive with the Dissected Till Plains and the Osage Plains physiographic regions. Pennsylvanian shales and thin sandstones are the principal bedrock types over much of the region. The streams of the Prairie Faunal Region occupy relatively broad valleys with high alluvial banks. Stream pools are relatively long and riffles may be poorly defined. Base flows tend to be low.

The Prairie-Neosho Division includes the Little North Fork and North Fork of the Spring River drainages, excluding Buck Branch and lower Dry Fork. This division spans both the Osage Plains and Springfield Plateau in southwest Missouri. The uplands are level to gently rolling and the streams occupy broad, shallow valleys. Stream pools are long, separated by short riffles, and composed of rock and gravel.

Channel Alterations

Channel alterations in the watershed include modifications to urban stream courses, channelization associated with road and bridge construction, channel modifications related to gravel removal, and efforts by individual landowners to control streambank erosion and similar problems. Instream gravel mining operations are typically small, few in number, and scattered.

Unique Habitats

There are six major categories of terrestrial natural resources classified in the state—Forest, Savanna, Prairie, Primary, Wetland, and Cave. The communities are divided based on characteristic features such as topography, size, distribution, and characteristic plants associated with the community (Nelson 1985).

The Missouri Department of Conservation Natural Heritage Program has identified unique natural communities in the Spring River drainage in four of the major categories; Forest, Prairie, Primary, and Wetland (Table 15).

The Forest community is an upland chert forest. The Primary community is a glade community, and the Wetland community is a groundwater seep (Nelson 1985).

The Prairie category is the most prevalent of the listed communities and contains representatives from limestone/shale, limestone/dolomite, chert glade, sandstone/shale, mesic, and hardpan prairie subdivisions

(Nelson 1985).

In addition to unique terrestrial communities, the basin supports several natural areas designated by the Missouri Natural Areas Committee. The Committee defines a natural area as ". . . biological communities or geological sites that preserve and are managed to perpetuate the natural character, diversity, and ecological processes of Missouri's native landscapes. They are permanently protected and managed for the purpose of preserving their natural qualities."

These areas are designated by the committee to aid in the management and restoration of the best examples of the extant communities found in each section of the state (Kramer et. al 1996). The Missouri Natural Areas Committee has designated four natural areas within the basin. These are: Wildcat Glade and Diamond Grove Prairie Natural Areas, Newton County; Mt. Vernon Prairie Natural Area, Lawrence County; and Wah-Sha-She Prairie Natural Area, Jasper County. More detailed information on each of these areas can be found in the Public Areas section of this document and Kramer et. al (1996).

Improvement Projects

As in most basins, there have been a variety of attempts by private landowners to stabilize streambanks. These attempts include channelization and bank armoring using a variety of materials including rock, gravel, and construction debris.

MDC personnel have installed three improvement projects since 1989, one on MDC property and two on private property (Table 16).

Table 15. Unique terrestrial habitats found in the Spring River Basin.

COMMUNITY TYPE	AREA NAME	T R S	SIZE (AC)	OWNERSHIP
ACID SEEP	WEST STAR PRAIRIE	31N 33W 11	2	PRIVATE
CHERT GLADE	PIONEER GLADE	25N 29W 36	-	PRIVATE
CHERT GLADE	YO-KO-MO GLADE	25N 29W 36	-	PRIVATE
CHERT GLADE	JOYCE CREEK GLADES	24N 29W 14	-	PRIVATE
CHERT GLADE	FILMORE BRIDGE GLADE	27N 33W 29	1.7	PRIVATE
CHERT GLADE	CHRISTIAN CAMP GLADE	27N 33W 29	1	PRIVATE
CHERT GLADE	TANYARD HOLLOW GLADE	27N 33W 20	1.5	PRIVATE
CHERT GLADE	GRAND FALLS GLADE	27N 33W 28	-	JOPLIN WATER
CHERT GLADE	GLENDALE DRIVE GLADE	27N 33W 27	4	PRIVATE
CHERT GLADE	WILD CAT GLADE N.A.	27N 33W 27	13	MDC/CITY OF JOPLIN
CHERT GLADE	WILD CAT CITY PARK N.	27N 33W 27	6	CITY OF JOPLIN
CHERT GLADE	SILVER CREEK GLADE	27N 33W 27	13.O	CITY OF JOPLIN
CHERT GLADE	SILVER CREEK GLADE E.	27N 33W 26	2.5	PRIVATE
CHERT GLADE	RICHARDSON GLADE S.	27N 33W 34	6.5	PRIVATE
CHERT GLADE	RICHARDSON GLADE N.	27N 33W 34	5	PRIVATE
CHERT GLADE	SHOAL BRIDGE GLADE	27N 33W 35	3	PRIVATE
CHERT GLADE	SHOAL BRANCH GLADE	27N 33W 33	2.5	PRIVATE

COMMUNITY TYPE	AREA NAME	T R S	SIZE (AC)	OWNERSHIP
CHERT GLADE	RICHARDSON GLADE E.	27N 33W 34	0.8	PRIVATE
DRY SANDSTONE/SHALE PRAIRIE	LEDBETTER SCHOOL PRAIRIE	32N 31W 34	125	PRIVATE
DRY SANDSTONE/SHALE PRAIRIE	WADDELL PRAIRIE	31N 31W 11	59	PRIVATE
DRY SANDSTONE/SHALE PRAIRIE	BETHEL CHURCH PRAIRIE	31N 31W 32	23.O	PRIVATE
DRY MESIC CHERT FOREST	WILDWOOD RANCH	27N 34W 23	35	PRIVATE
DRY MESIC CHERT PRAIRIE	SWEENEY PRAIRIE	31N 29W 6	25	PRIVATE
DRY MESIC CHERT PRAIRIE	SHELDON L. COOK MEM. MEADOW	31N 29W 2	180	THE NATURE CONSERVANCY
DRY MESIC CHERT PRAIRIE	LOUSY BRANCH PRAIRIE	31N 28W 11	580	PRIVATE
DRY MESIC CHERT PRAIRIE	MEINERT BRANCH PRAIRIE	30N 28W 22	42	PRIVATE
DRY MESIC CHERT PRAIRIE	ACME PRAIRIE	28N 32W 32	541	ACME LAND CO.
DRY MESIC CHERT PRAIRIE	DUQUESNE PRAIRIE	27N 32W 17	234	ACME LAND CO.
DRY MESIC CHERT PRAIRIE	COX PRAIRIE	28N 27W 1	140	PRIVATE
DRY MESIC CHERT PRAIRIE	PROVIDENCE PRAIRIE C.A.	29N 28W 4	198	MDC
DRY MESIC CHERT PRAIRIE	MOUNT VERNON PRAIRIE N.A.	28N 26W 17	40	THE NATURE CONSERVANCY
DRY MESIC CHERT PRAIRIE	POIROT PRAIRIE	29N 28W 3	60	PRIVATE
DRY MESIC CHERT PRAIRIE	HARRINGTON PRAIRIE	28N 27W 30	60	PRIVATE
DRY MESIC CHERT PRAIRIE	DIAMOND GROVE PARK N.A.	27N 32W 36	782	MDC/PRIVATE

COMMUNITY TYPE	AREA NAME	T R S	SIZE (AC)	OWNERSHIP
DRY MESIC CHERT PRAIRIE	CRELDON PRAIRIE	27N 32W 22	40	PRIVATE
DRY MESIC LIMESTONE/DOLOMITE PRAIRIE	DORRIS CREEK C.A.	31N 30W 33	293	MDC/PRIVATE
DRY MESIC LIMESTONE/DOLOMITE PRAIRIE	PETTIS CREEK PRAIRIE	31N 29W 28	35	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	CENTRAL PRAIRIE	32N 32W 15	346	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	MOREY PRAIRIE	32N 30W 34	19	PRIVATE
DRY MESIC SNADSTONE/SHALE PRAIRIE	ESROM PRAIRIE	31N 31W 30	175.O	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	LAMAR AIRPORT PRAIRIE	32N 31W 26	43	PRIVATE/CITY OF LAMAR
DRY MESIC SANDSTONE/SHALE PRAIRIE	ALYEA PRAIRIE	31N 31W 2	62	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	BARTON-JASPER CO. LINE PRAIRIE	30N 33W 7	30.7	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	DUNKIN PRAIRIE	32N 29W 27	37.7	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	ADAMS PRAIRIE	32N 30W 28	44	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	DUVAL CREEK PRAIRIE	30N 32W 11	118	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	LUTHI PRAIRIE	31N 32W 34	63	PRIVATE
DRY MESIC	DUVAL CREEK	31N 32W	93	PRIVATE

COMMUNITY TYPE	AREA NAME	T R S	SIZE (AC)	OWNERSHIP
SANDSTONE/SHALE PRAIRIE	PRAIRIE	35		
DRY MESIC SANDSTONE/SHALE PRAIRIE	BOWER PRAIRIE	30N 33W 2	32	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	MCKIBBEN PRAIRIE	32N 31W 31	83	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	FRIEDEN PRAIRIE	31N 33W 22	232	PRIVATE
DRY MESIC SANDSTONE/SHALE PRAIRIE	JOHNSON PRAIRIE	30N 33W 14	258	PRIVATE
HARDPAN PRAIRIE	GOLDEN PRAIRIE	30N 29W 8	270	MO. PRAIRIE FOUNDATION/PRIVATE
HARDPAN PRAIRIE	SHAWNEE TRAIL C.A.	31N 33W 20	17	MDC
HARDPAN PRAIRIE	RADIO TOWER PRAIRIE	30N 30W 7	64	PRIVATE
HARDPAN PRAIRIE	MILLER-OAKTON PRAIRIE	31N 30W 22	95	PRIVATE
HARDPAN PRAIRIE	PETTIS CREEK PRAIRIE	31N 29W 28	85	PRIVATE
HARDPAN PRAIRIE	BRINKERHOF PRAIRIE	32N 30W 36	14	PRIVATE
HARDPAN PRAIRIE	BANTA PRAIRIE	31N 30W 23	38.9	PRIVATE
HARDPAN PRAIRIE	MORGAN PRAIRIE	32N 31W 35	35	PRIVATE
HARDPAN PRAIRIE	LEDBETTER PRAIRIE	32N 31W 34	35	PRIVATE
HARDPAN PRAIRIE	ALYEA PRAIRIE	31N 31W 2	81	PRIVATE
HARDPAN PRAIRIE	ISENMANN PRAIRIE	30N 31W 1	35	PRIVATE
HARDPAN PRAIRIE	DALTON HARRIS PRAIRIE	31N 30W 22	31	PRIVATE

COMMUNITY TYPE	AREA NAME	T R S	SIZE (AC)	OWNERSHIP
HARDPAN PRAIRIE	MARTI PRAIRIE	31N 32W 3	40	PRIVATE
HARDPAN PRAIRIE	BENNETT PRAIRIE	30N 32W 4	28	PRIVATE
HARDPAN PRAIRIE	DINGMAN PRAIRIE	31N 32W 18	46	PRIVATE
HARDPAN PRAIRIE	SELVEY PRAIRIE	32N 32W 28	43	PRIVATE
HARDPAN PRAIRIE	GLENDALE FORK PRAIRIE	31N 33W 15	95	PRIVATE
HARDPAN PRAIRIE	MOSS LAKE PRAIRIE	31N 33W 21	72	PRIVATE
HARDPAN PRAIRIE	GARDNER PRAIRIE	31N 33W 22	153	PRIVATE
HARDPAN PRAIRIE	SLAPPER PRAIRIE	31N 33W 31	44	PRIVATE
HARDPAN PRAIRIE	BURNS PRAIRIE	31N 28W 28	23	PRIVATE
HARDPAN PRAIRIE	KAELKE PRAIRIE	30N 28W 16	165	PRIVATE
HARDPAN PRAIRIE	GLANDLACH TRACT	31N 28W 29	60	PRIVATE
HARDPAN PRAIRIE	BURNS MEADOW	31N 28W 28	240	PRIVATE
HARDPAN PRAIRIE	HORSE CREEK PRAIRIE	31N 28W 26	160	PRIVATE
HARDPAN PRAIRIE	KAELKE PRAIRIE	31N 28W 27	53	PRIVATE
HARDPAN PRAIRIE	FISH FARM PRAIRIE	30N 28W 2	30	PRIVATE
HARDPAN PRAIRIE	WAH-SHA-SHE PRAIRIE	30N 33W 31	260	PRIVATE
HARDPAN PRAIRIE	BASTIN PRAIRIE	30N 30W 23	62	PRIVATE
HARDPAN PRAIRIE	BARTON-JASPER CO. LINE PRAIRIE	30N 31W 17	136	PRIVATE
HARDPAN PRAIRIE	ASBURY PRAIRIE	29N 34W 2	70	PRIVATE
HARDPAN PRAIRIE	WAH-SHA-SHE	29N 34W 2	58	PRIVATE

COMMUNITY TYPE	AREA NAME	T R S	SIZE (AC)	OWNERSHIP
	PRAIRIE S.			
HARDPAN PRAIRIE	WAH-SHA-SHE PRAIRIE N.	30N 33W 31	90	PRIVATE
HARDPAN PRAIRIE	WAH-SHA-SHE PRAIRIE E.	30N 33W 32	98	PRIVATE
HARDPAN PRAIRIE	BLACKBERRY TRIBUTARY PRAIRIE	30N 33W 21	152	PRIVATE
HARDPAN PRAIRIE	GRAVES PRAIRIE	29N 38W 5	135	PRIVATE
HARDPAN PRAIRIE	POIROT PRAIRIE	29N 28W 6	229	PRIVATE
HARDPAN PRAIRIE	WILDWOOD RANCH	27N 34W 23	120	PRIVATE
MESIC PRAIRIE	PLOVER PRAIRIE	31N 33W 25	/	PRIVATE
WET MESIC PRAIRIE	ESROM PRAIRIE	31N 31W 30	17	PRIVATE
WET MESIC PRAIRIE	GOLDEN PRAIRIE	30N 29W 8	38	MO. PRAIRIE FOUNDATION
WET MESIC PRAIRIE	MOREY PRAIRIE	32N 30W 34	9	PRIVATE
WET MESIC PRAIRIE	MARTI PRAIRIE	31N 32W 3	10	PRIVATE
WET MESIC PRAIRIE	DINGMAN PRAIRIE	31N 32W 18	8	PRIVATE
WET MESIC PRAIRIE	DUVAL SCHOOL PRAIRIE	31N 32W 27	9	PRIVATE
WET MESIC PRAIRIE	DADE-BARTON CO. LINE	31N 29W 36	8	PRIVATE

Source: MDC (1996b).

Stream Habitat Assessment

Stream habitat assessments (SHAD) were completed at 107 sites throughout the basin in 1990 by Fisheries District 9 staff (Table 17 and Figure 5A-F). SHAD sites were selected in all of the major sub-basins using the guidelines of Bovee (1982).

SHAD assessments are summarized in Table 18. More detailed information is available from MDC's Southwest Regional Office in Springfield, MO.

Stream habitat quality is fair to good throughout most of the basin. Some areas suffer from a lack of riparian vegetation. The lack of adequate riparian vegetation, effects of runoff from mined lands,

excessive nutrient loading, streambank erosion, excessive runoff and erosion, and the effects of instream activities such as gravel mining are among the problems observed.

Table 16. Missouri Department of Conservation streambank restoration and habitat improvement projects in the Spring River Basin.

STREAM	COUNTY	PRACTICE	LOCATION (T R S)	OWNER	INSTALLATION DATE
Dry Fork Creek	Lawrence	Rock Blanket	28N, 27W, 05	MDC	1994
Shoal Creek	Barry	Revetment	24N, 29W, 14	Private	1992
Shoal Creek	Newton	Revegetation	21N, 30W, 25	Private	1992

Table 17. Location of stream habitat sampling sites (SHAD) in the Spring River basin.

Stream	ID#	Order	Location	Stream Mile	Topographic Map	Date
Baynham Branch	89	3	26N-31W-19	2.7	Granby	8/17/90
Blackberry Cr.	2	4	29N-33W-05	1.9	Asbury	12/13/90
Blackberry Cr.	3	3	30N-33W-21	6.9	Asbury	12/13/90
Capps Creek	101	4	25N-29W-15	0.5	Pierce City	8/16/90
Capps Creek	102	3	25N-29W-12	3	Pierce City	8/14/90
Capps Creek	103	3	25N-28W-21	6.5	Wheaton	8/14/90
Cave Spring Br.	45	3	28N-29W-22	1.1	La Russell	10/26/90
Cave Spring Br.	46	3	28N-29W-26	3.8	Sarcoxie	10/26/90
Center Creek	7	6	28N-34W-12	3	Carl Jnc.	12/12/90
Center Creek	70	6	28N-33W-01	10	Webb City	12/12/90
Center Creek	71	6	28N-32W-24	19.6	Webb City	12/5/90
Center Creek	74	6	28N-31W-32	24.1	Fidelity	12/5/90
Center Creek	79	5	27N-29W-03	35.5	Reeds	12/6/90
Center Creek	80	5	26N-28W-22	46.7	Sarcoxie	11/26/90
Center Creek	81	4	27N-28W-17	52.4	Sarcoxie	12/6/90
Center Creek	82	4	26N-27W-26	56.1	Stotts City	8/16/90
Clear Creek	95	5	26N-29W-29	1.5	Newtonia	8/9/90
Clear Creek	98	4	26N-28W-29	9.3	Pierce City	8/9/90
Clear Creek	99	4	26N-28W-26	12.9	Monett	8/9/90
Coon Creek	35	3	30N-29W-12	0.7	Dudenville	12/12/90
Coon Creek	36	3	29N-29W-02	7.1	Dudenville	12/12/90
Coon Creek	19	4	30N-30W-17	3.5	Jasper	12/13/90

Stream	ID#	Order	Location	Stream Mile	Topographic Map	Date
Coon Creek	20	4	30N-30W-10	6	Maple Grove	12/13/90
Coon Creek	21	4	30N-29W-20	11.3	Maple Grove	12/12/90
Deer Creek	16	3	29N-29W-02	3.7	Maple Grove	12/10/90
Deer Creek	17	3	29N-29W-04	8.9	Dudenville	12/10/90
Dicks Ford	24	3	31N-31W-03	0.8	Lamar South	12/7/90
Dicks Ford	25	3	32N-31W-27	4.4	Lamar South	12/7/90
Dorris Creek	29	4	31N-30W-21	2.5	Kenoma	12/6/90
Douthit Branch	96	4	26N-29W-29	1.2	Pierce City	8/9/90
Douthit Branch	97	3	26N-29W-21	1.9	Pierce City	8/9/90
Dry Fork	52	3	28N-27W-05	1.5	Rescue	8/10/90
Dry Fork	14	5	29N-31W-05	1.5	Jasper	12/14/90
Dry Fork	15	5	29N-30W-08	9.1	Maple Grove	12/10/90
Dry Fork	18	3	29N-30W-15	11.7	Avilla	12/10/90
Dry Hollow	48	4	28N-28W-27	1.6	Stotts City	8/22/90
Dry Hollow	49	3	28N-28W-35	2.9	Stotts City	8/22/90
Duvall Creek	11	3	30N-32W-32	1.5	Neck City	12/14/90
Duvall Creek	12	3	30N-32W-14	8.4	Neck City	12/14/90
Elm Branch	64	3	27N-26W-24	0.2	Chesapeake	8/8/90

Stream	ID#	Order	Location	Stream Mile	Topographic Map	Date
Elm Branch	32	4	32N-30W-09	2.2	Milford	12/6/90
Elm Spring Br.	91	3	24N-31W-06	1.7	Neosho	8/17/90
Glendale Fork	7	4	31N-33W-35	0.7	Mindenmines	12/12/90
Glendale Fork	8	4	31N-33W-23	3.9	Mindenmines	12/12/90
Glendale Fork	9	3	31N-33W-15	5.4	Mindenmines	12/12/90
Grove Creek	72	3	28N-32W-25	0.6	Joplin East	12/7/90
Grove Creek	73	3	27N-32W-13	4.9	Fidelity	12/7/90
Hickory Creek	90	4	25N-31W-26	4.1	Neosho East	8/17/90
Hickory Creek	92	2	25N-31W-28	7.5	Neosho East	8/17/90
Honey Creek	62	4	27N-27W-02	1.2	Mt Vernon	8/8/90
Honey Creek	63	4	27N-26W-23	8.8	Mt Vernon	8/8/90
Honey Creek	65	3	27N-25W-27	15.6	Chesapeake	8/8/90
Jenkins Creek	76	4	27N-30W-16	4.3	Reeds	11/26/90
Jenkins Creek	77	2	27N-30W-27	7.6	Reeds	12/6/90
Jones Creek	75	5	27N-31W-02	1.8	Fidelity	12/5/90
Jones Creek	78	4	27N-31W-24	5.6	Fidelity	11/26/90
Joyce Creek	107	3	24N-28W-17	2.9	Purdy	8/13/90
L. N. Fork	4	5	30N-33W-35	1.9	Asbury	12/13/90
L. N. Fork	5	5	30N-33W-12	8.7	Asbury	12/12/90
L. N. Fork	6	4	31N-32W-30	14.5	Mindenmines	12/12/90
N. Fk. Spring R	10	6	29N-33W-03	2.7	Asbury	12/13/90

Stream	ID#	Order	Location	Stream Mile	Topographic Map	Date
N. Fk. Spring R	13	6	29N-32W-02	14.7	Neck City	12/14/90
N. Fk. Spring R	22	6	31N-31W-23	32.3	Lamar South	12/13/90
N. Fk. Spring R	33	5	31N-29W-09	59	Golden City	12/6/90
N. Fk. Spring R	34	5	31N-29W-35	65.1	Golden City	12/6/90
N. Fk. Spring R	37	4	30N-28W-17	71.2	Dudenville	12/12/90
N. Fk. Spring R	38	3	30N-28W-17	72	Dudenville	12/12/90
Pettis Creek	28	5	31N-30W-18	2.2	Lamar South	12/13/90
Pettis Creek	30	4	31N-30W-09	4.7	Kenoma	12/13/90
Pettis Creek	31	3	31N-30W-24	9.1	Kenoma	12/6/90
Shoal Creek	86	6	27N-33W-29	10.6	Joplin West	10/31/90
Shoal Creek	87	6	26N-32W-06	17.6	Joplin East	10/31/90
Shoal Creek	88	6	26N-32W-16	21	Tipton Ford	10/31/90
Shoal Creek	93	6	25N-31W-05	34.5	Granby	10/31/90
Shoal Creek	94	6	26N-30W-27	47.4	Newtonia	8/16/90
Shoal Creek	100	5	25N-29W-08	53.5	Newtonia	8/16/90
Shoal Creek	104	4	24N-29W-10	63.3	Wheaton	8/13/90
Shoal Creek	105	4	23N-28W-12	71.2	Rocky Comfort	8/13/90
Shoal Creek	106	3	23N-28W-29	75.3	Exeter	8/13/90
Spring River	1	7	29N-33W-07	48.66	Carl Jnc.	12/13/90
Spring River	39	6	29N-32W-17	59.8	Webb City	12/12/90

Stream	ID#	Order	Location	Stream Mile	Topographic Map	Date
Spring River	40	6	29N-31W-31	67.1	Carthage	12/12/90
Spring River	41	6	28N-30W-04	76.9	Avilla	12/12/90
Spring River	47	6	28N-29W-11	88.6	La Russell	10/26/90
Spring River	50	6	28N-27W-18	99.3	Rescue	10/15/90
Spring River	54	6	28N-27W-29	103.5	Stotts City	8/10/90
Spring River	61	4	27N-27W-02	108.3	Mt Vernon	8/10/90
Spring River	66	4	27N-27W-25	114.4	Mt Vernon	8/7/90
Spring River	67	4	26N-26W-08	119.5	Verona	8/7/90
Spring River	68	3	26N-26W-28	122.8	Verona	8/7/90
Stahl Creek	51	4	28N-27W-18	0.7	Rescue	8/10/90
Stahl Creek	53	3	28N-27W-04	3.4	Rescue	8/10/90
Truitt Creek	57	4	28N-27W-23	1.7	Mt Vernon	8/9/90
Truitt Creek	58	3	29N-26W-33	8.3	Miller	0809-90
Turkey Creek	83	4	28N-34W-26	1.3	Carl Jnc.	12/7/90
Turkey Creek	84	4	28N-33W-33	5.6	Joplin West	12/7/90
Turkey Creek	85	3	27N-32W-05	11.5	Joplin East	12/7/90
West Fork	23	4	31N-31W-10	2.6	Lamar South	12/7/90
West Fork	26	4	31N-31W-06	7.4	Nashville	12/7/90
West Fork	27	3	32N-32W-36	10.7	Nashville	12/7/90
White Oak Cr.	42	4	28N-29W-05	2.6	Avilla	9/10/90
White Oak Cr.	43	4	28N-29W-24	9.8	La Russell	9/10/90

Stream	ID#	Order	Location	Stream Mile	Topographic Map	Date
White Oak Cr.	44	3	29N-28W-08	13.4	La Russell	9/10/90
Williams Cr.	56	5	28N-27W-34	2.5	Mt Vernon	8/9/90
Williams Cr.	59	4	28N-26W-30	6.3	Mt Vernon	8/9/90
Williams Cr.	60	3	28N-26W-34	9.8	Mt Vernon	8/9/90
Unnamed trib to Spring R.	55	4	28N-27W-32	1	Stotts City	8/10/90

Biotic Communities

Aquatic Community Data

Since the basin contains two major aquatic community divisions, the Ozark-Neosho and the Prairie-Neosho, the Spring River Basin is probably one of the most diverse in fish community structure in the state. The Ozark-Neosho region is the most unique of the Ozark divisions and has numerous species distinctive to the region. These species include the redspot chub, bluntface shiner, cardinal shiner, southwestern mimic shiner, western slim minnow, Neosho madtom, Arkansas darter, Neosho orangethroat darter, redfin darter, and channel darter. The fishes of the Prairie-Neosho Division are common to most prairie streams; however this particular prairie division includes species which are common to the Ozark-Neosho Division as well. These species include the bluntface shiner, spotfin shiner, western slim minnow, southwestern mimic shiner, Arkansas darter, Neosho orangethroat darter, redfin darter, and channel darter. The spotted sucker and brindled madtom are unique to the Prairie-Neosho Division (Pflieger 1989).

This drainage includes only five crayfish species—the bristly cave crayfish *(Cambarus setosus),* the Neosho midget crayfish *(Orconectes macrus),* the ringed crayfish *(Orconectes neglectus),* the northern crayfish *(Orconectes virilis),* and the grassland crayfish *(Procambarus gracilis)* (Pflieger 1996). The Neosho midget crayfish and the ringed crayfish are limited to this region (Pflieger 1989).

The graybelly salamander *(Eurycea multiplicata griesogaster),* the Oklahoma salamander *(Eurycea tynerensis),* the yellow mud turtle *(Kinosternon flavescens),* the Texas horned lizard *(Phrynosoma cornutum),* and the ground snake *(Sonora semiannulata)* all have distributions limited to this region of the state (Johnson 1987).

The Spring River Basin has a very diverse naiad fauna, (Table 19). The rabbit's foot *(Quadrula cylindrica cylindrica)* and the western fanshell *(Cyprogenia aberti)* have localized distributions in the basin (Oesch 1984). It is thought that the Neosho mucket *(Lampsilis rafinesqueana)* is restricted to the basin (Pflieger 1989).

Fish Community Data

Fish collections have been made in various locations throughout the basin since the 1930s (Table 20). Eighty-six species have been collected in the basin since that time (Table 21). Fish were collected in 1991 and 1992 by MDCs Fisheries District 9 staff (Table 22 and Figures 6A-F). Fish species distributions by stream are found in Table 23a. In addition to collections made by MDC staff, Dan Beckman, Ph.D., at Southwest Missouri State regularly samples the Spring River at Verona as part of his ichthyology course (Table 24).

There are several species which were collected by Pflieger historically but have been absent from collections made recently by Beckman and District 9 staff. These species are:

- Bigmouth buffalo Ictiobus cyprinellus
- River carpsucker *Carpiodes carpio*
- River redhorse Moxostoma carinatum
- Goldfish Carassius auratus

Table 19. Mussel species found in the Spring River Basin

Common Name	Scientific Name
Paper floater	*Anodonta imbecilis*
Giant floater	*Anodonta grandis grandis*
Squaw Foot	*Strophitus undulatus undulatus*
Elk toe	*Alasmidonta marginata*
Slipper shell	*Alasmidonta viridis*
White heel-splitter	*Lasmigona complanata*
Fluted shell	*Lasmigona costata*
Pistol-grip	*Tritogonia verrucosa*
Maple leaf	*Quadrula quadrula*
Rabbit's foot	*Quadrula cylindrica cylindrica*
Monkey face	*Quadrula metanevra*
Pimple-back	*Quadrula pustulosa*
Three-ridge	*Amblema plicata plicata*
Wabash pig-toe	*Fusconaia flava*
Ozark shell	*Fusconaia ozarkensis*
Round pig-toe	*Pleurobema coccineum*
Lady-finger	*Elliptio dilata*
Kidney-shell	*Ptychobranchus occidentalis*
Western fanshell	*Cyprogenia aberti*
Mucket	*Actinonaias ligamentina carinata*
Plea's mussel	*Venustaconcha ellipsiformis*
Fawn's foot	*Truncilla donaciformis*
Deer-toe	*Truncilla truncata*
Fragile paper shell	*Leptodea fragilis*
Liliput shell	*Toxolasma parvus*
Little purple	*Toxolasma lividus glans*
Pond mussel	*Ligumia subrostrata*
Slough sand shell	*Lampsilis teres teres*

Common Name	Scientific Name
Yellow sand shell	*Lampsilis teres anodontoides*
Fat mucket	*Lampsilis radiata luteola*
Neosho mucket	*Lampsilis rafinesqueana*
Pocketbook	*Lampsilis ventricosa*
Broken rays	*Lampsilis reeviana brevicula*
Purple pimpleback	*Cyclonaias tuberculata*
Black sand shell	*Ligumia recta*

Table 20. Fish species of the Spring River Basin.

COMMON NAME	SPECIES NAME	STATUS
Shortnose gar	*Lepisosteus platostomus*	D
Longnose gar	*Lepisosteus osseus*	A, B, D, E
Gizzard shad	*Dorosoma cepedianum*	A, B, C, E
Bigmouth buffalo	*Ictiobus cyprinellus*	B
Black buffalo	*Ictiobus niger*	A, E
River carpsucker	*Carpiodes carpio*	B
Spotted sucker	*Minytrema melanops*	A, B, C, D, E, F
White sucker	*Catostomus commersoni*	A, B, C, D, E, F
River redhorse	*Moxostoma carinatum*	A, B
Black redhorse	*Moxostoma duquesnei*	A, B, D, E, F
Golden redhorse	*Moxostoma erythrurum*	A, B, C, D, E, F
Shorthead redhorse	*Moxostoma macrolepidotum*	A, B, C, D, E, F
Northern hog sucker	*Hypentelium nigricans*	A, B, C, D, E, F
Rainbow trout	*Oncorhynchus mykiss*	B, C, D
Common Carp	*Cyprinus carpio*	B, C, D, F
Flathead catfish	*Pylodictis olivaris*	B, C, E, F
Channel catfish	*Ictalurus punctatus*	A, B, C, D, E, F
Black bullhead	*Ameiurus melas*	A, B, C, D, E, F
Yellow bullhead	*Ameiurus natalis*	A, B, C, D, E, F
Warmouth	*Lepomis gulosus*	D, E
Redear sunfish	*Lepomis microlophus*	E, F
Pumpkinseed sunfish	*Lepomis gibbosus*	E
Orangespotted sunfish	*Lepomis humilis*	A, B, C, D, E, F
Green sunfish	*Lepomis cyanellus*	A, B, C, D, E, F
Bluegill	*Lepomis macrochirus*	A, B, C, D, E, F
Longear sunfish	*Lepomis megalotis*	A, B, C, D, E, F
Largemouth bass	*Micropterus salmoides*	A, B, C, D, E, F
Spotted bass	*Micropterus punctulatus*	A, B, C, D, E, F

COMMON NAME	SPECIES NAME	STATUS
Smallmouth bass	*Micropterus dolomieui*	A, B, C, D, E, F
White crappie	*Pomoxis annularis*	A, B, C, D, E, F
Black crappie	*Pomoxis nigromaculatus*	B, E, F
Rock bass	*Ambloplites rupestris*	A, B, C, D, E, F
Goldfish	*Carassius auratus*	B
Pugnose minnow	*Opsopoeodus emiliae*	A
Central stoneroller	*Campostoma anomalum*	A, B, C, D, E, F
Fathead minnow	*Pimephales promelas*	B, C, F
Slim minnow	*Pimephales tenellus tenellus*	A, B, C, D, E, F
Bluntnose minnow	*Pimephales notatus*	A, B, C, D, E, F
Bullhead minnow	*Pimephales vigilax*	F
Cardinal shiner	*Luxilus cardinalis*	A, B, C, D, E, F
Striped shiner	*Luxilus crysocephalus*	A, B, D, E, F
Bluntface shiner	*Cyprinella camura*	A, B, C, D, E, F
Red shiner	*Cyprinella lutrensis*	A, B, C, D, E, F
Spotfin shiner	*Cyprinella spilotera*	A, B, C, E, F
Western redfin shiner	*Lythrurus umbratilis umbratilis*	A, B, C, D, E, F
Creek chub	*Semotilus atromaculatus*	A, B, C, D, E, F
Ozark minnow	*Notropis nubilus*	A, B, C, D, E, F
Bigeye shiner	*Notropis boops*	A, B, C, D, E, F
Mimic shiner	*Notropis volucellus*	A, B, C, E, F
Ghost shiner	*Notropis buchanani*	B, C, F
Rosyface shiner	*Notropis rubellus*	A, B, C, D, E, F
Southern redbelly dace	*Phoxinus erythrogaster*	A, B, C, D, E, F
Suckermouth minnow	*Phenacobis mirabilis*	A, B, C, D, E, F
Bigeye chub	*Hybopsis amblops*	A, B
Gravel chub	*Hybopsis x punctatus*	B, C, E, F
Redspot chub	*Nocomis asper*	A, B, C, D, E, F
Hornyhead chub	*Nocomis biguttatus*	E

COMMON NAME	SPECIES NAME	STATUS
Golden shiner	*Notemigonus crysoleucas*	B, C, D, E
Blackspotted topminnow	*Fundulus olivaceus*	D, F
Blackstriped topminnow	*Fundulus notatus*	A, B, C, D, E, F
Northern studfish	*Fundulus catenatus*	E
Plains topminnow	*Fundulus sciadicus*	A, B, E
Mosquitofish	*Gambusia affinis*	B, C, D, E, F
Brook silverside	*Labidesthes sicculus*	A, B, C, D, E, F
Banded sculpin	*Cottus carolinae*	A, B, C, D, E, F
Slender madtom	*Noturus exilis*	A, B, C, D, E, F
Brindled madtom	*Noturus miurus*	A, B, C, E, F
Stonecat	*Noturus flavus*	B, C, E, F
Neosho madtom	*Noturus placidus*	B, C, E, F
Freckled madtom	*Noturus nocturnus*	A
Tadpole madtom	*Noturus gyrinus*	B
Logperch	*Percina caprodes*	A, B, C, D, E, F
Channel darter	*Percina copelandi*	A, B, C, D, E, F
Slenderhead darter	*Percina phoxocephala*	B, C, E, F
Greenside darter	*Etheostoma blennioides*	A, B, C, D, E, F
Stippled darter	*Etheostoma punctulatum*	A, B, C, D, E, F
Johnny darter	*Etheostoma nigrum*	A, B, C, D, E, F
Speckled darter	*Etheostoma stigmaeum*	A, B, C, D, E, F
Banded darter	*Etheostoma zonale*	A, B, C, D, E, F
Fantail darter	*Etheostoma flabellare*	A, B, C, D, E, F
Orangethroat darter	*Etheostoma spectabile*	A, B, C, D, E, F
Arkansas darter	*Etheostoma cragini*	A, B, C, D, E, F
Redfin darter	*Etheostoma whipplei*	A, B, C, E
Slough darter	*Etheostoma gracile*	A, C, F

Source: MDC Fish Collection Database Records and Summary dated 1995, Wilkinson and Edds (1996), Wildhaber et. al (1996), USFWS (1991).

Status:

A—Collected before 1946

B—Collected between 1947 and 1973

Table 23. Fish species list by stream in the Spring River Basin.

Species	Big Spring	Blackberry Creek	Buck Branch	Buffalo Creek	Capps Creek	Cedar Creek
Lepisosteus platostomus						
Lepisosteus osseus						
Dorosoma cepedianum						
Ictiobus niger			X			
Carpiodes carpio						
Minytrema melanops						
Catostomus commersoni					X	
Moxostoma carinatum						
Moxostoma duquesnei						
Moxostoma erythrurum		X				
Moxostoma macrolepidotum						
Hypentelium nigricans				X	X	
Oncorhynchus mykiss		X				
Cyprinus carpio						
Pylodictis olivaris						
Ictalurus punctatus						
Ameiurus melas						
Ameiurus natalis		X				
Lepomis gulosus		X				

Species	Center Creek	Clear Creek	Coon Creek	Deer Creek	Doris Creek	Douthit Creek
Lepisosteus platostomus	X					
Lepisosteus osseus			X			
Dorosoma cepedianum						
Ictiobus niger						
Carpiodes carpio						
Minytrema melanops			X	X		
Catostomus commersoni	X	X				
Moxostoma carinatum	X					
Moxostoma duquesnei	X	X				
Moxostoma erythrurum	X	X	X			
Moxostoma macrolepidotum	X					
Hypentelium nigricans	X	X				
Oncorhynchus mykiss		X				
Cyprinus carpio	X					
Pylodictis olivaris						
Ictalurus punctatus	X					
Ameiurus melas	X				X	
Ameiurus natalis						
Lepomis gulosus	X					

Species	Big Spring	Blackberry Creek	Buck Branch	Buffalo Creek	Capps Creek	Cedar Creek
Lepomis						

Species	Big Spring	Blackberry Creek	Buck Branch	Buffalo Creek	Capps Creek	Cedar Creek
microlophus						
Lepomis gibbosus						
Lepomis humilis			X			
Lepomis cyanellus	X	X	X		X	
Lepomis macrochirus		X	X	X	X	
Lepomis megalotis		X	X		X	
Micropterus salmoides		X	X			
Micropterus punctulatus			X			
Micropterus dolomieui				X		
Pomoxis annularis			X			
Pomoxis nigromaculatus						
Ambloplites rupestria						
Carassius auratus						
Opsopoeodus emiliae						
Campostoma anomalum		X	X	X	X	
Pimephales promelas						
Pimephales tenellus						
Pimephales notatus		X	X			

Species	Center Creek	Clear Creek	Coon Creek	Deer Creek	Dorria Creek	Douthit Creek
Lepomis microlophus						
Lepomis gibbosus						

Species	Center Creek	Clear Creek	Coon Creek	Deer Creek	Dorria Creek	Douthit Creek
Lepomis humilis	X		X			
Lepomis cyanellus	X	X	X	X	X	X
Lepomis macrochirus	X		X	X	X	X
Lepomis megalotis	X		X	X		
Micropterus salmoides	X	X	X	X	X	
Micropterus punctulatus	X		X			
Micropterus dolomieui	X					
Pomoxis annularis	X					
Pomoxis nigromaculatus						
Ambloplites rupestria	X					
Carassius auratus						
Opsopoeodus emiliae						
Campostoma anomalum	X	X	X	X		X
Pimephales promelas						
Pimephales tenellus	X		X			
Pimephales notatus	X	X	X	X		

Species	Big Spring	Blackberry Creek	Buck Branch	Buffalo Creek	Capps Creek	Cedar Creek
Nocomis buguttatus				X		
Notemigonus crysoleucas			X			
Fundulus olivaceus					X	
Fundulus notatus		X	X			

Species	Big Spring	Blackberry Creek	Buck Branch	Buffalo Creek	Capps Creek	Cedar Creek
Fundulus catenatus				X		
Fundulus sciadicus						X
Gambusia affinis		X	X	X		
Labidesthes sicculus			X			
Cottus carolinae	X			X	X	
Noturus exilis				X	X	
Noturus miurus						
Noturus flavus						
Noturus placidus						
Noturus nocturnus						
Noturus gyrinus						
Percina caprodes			X			
Percina copelandi						
Percina phoxocephala						

Lost Creek	Center Creek	Clear Creek	Coon Creek	Deer Creek	Dorris Creek	Douthit Creek
Nocomis buguttatus						
Notemigonus crysoleucas	X		X			
Fundulus olivaceus		X				
Fundulus notatus	X		X	X	X	
Fundulus catenatus						
Fundulus sciadicus						
Gambusia affinis	X		X	X		
Labidesthes sicculus	X		X	X	X	
Cottus carolinae	X	X				X
Noturus exilis	X					
Noturus miurus	X					

Lost Creek	Center Creek	Clear Creek	Coon Creek	Deer Creek	Dorris Creek	Douthit Creek
Noturus flavus						
Noturus placidus						
Noturus nocturnus						
Noturus gyrinus						
Percina caprodes	X		X	X		
Percina copelandi	X					
Percina phoxocephala						

Lost Creek	Big Spring	Blackberry Creek	Buck Creek	Buffalo Creek	Capps Creek	Cedar Creek
Etheostoma blennioides		X			X	
Etheostoma punctulatum					X	
Etheostoma nigrum						
Etheostoma stigmaeum						
Etheostoma zonale						
Etheostoma flabellare		X		X	X	
Etheostoma spectabile		X	X	X	X	X
Ethestoma cragini		X				
Ethestoma whipplei						
Ethestoma gracile						
Ethestoma Chlorosomum						
Ethestoma microperca						

Lost Creek	Center Creek	Clear Creek	Coon Creek	Deer Creek	Dorris Creek	Douthit Creek
Etheostoma blennioides	X	X			X	
Etheostoma punctulatum	X				X	X
Etheostoma nigrum	X		X	X		
Etheostoma stigmaeum	X					
Etheostoma zonale	X					
Etheostoma flabellare	X		X		X	
Etheostoma spectabile	X	X	X	X	X	X
Ethestoma cragini	X			X		
Ethestoma whipplei						
Ethestoma gracile						
Ethestoma Chlorosomum						
Ethestoma microperca				X		

Lost Creek	Dry Fork	Elm Branch	Elm Spring Brnach	Glendale Fork	Hickory Creek	Honey Creek
Lepisosteus platostomus						
Lepisosteus osseus						
Dorosoma cepedianum						
Ictiobus cyprinellus						
Ictiobus niger						
Carpiodes carpio						
Minytrema melanops	X	X				

Lost Creek	Dry Fork	Elm Branch	Elm Spring Brnach	Glendale Fork	Hickory Creek	Honey Creek
Catostomus commersoni						X
Moxostoma carinatum						
Moxostoma duquesnei						X
Moxostoma erythrurum	X			X		X
Moxostoma macrolepidotum						
Hypentelium nigricians					X	X
Oncorhynchus mykiss					X	
Cyprinus carpio		X		X		X
Pylodictis olivaris						
Ictalurus punctatus						
Ameiurus melas	X	X		X		
Ameiurus natalis						
Lepomis gulosus						

Species	Indian Creek	Jenkins Creek	Jones Creek	Joyce Creek	Little North Fork	Lost Creek
Lepisosteus platostomus					X	
Dorosoma cepedianum						
Ictiobus cyprinellus						
Ictiobus niger						
Carpiodes carpio						
Minytrema melanops					X	

Species	Indian Creek	Jenkins Creek	Jones Creek	Joyce Creek	Little North Fork	Lost Creek
Catostomus commersoni						
Moxostoma carinatum						
Moxostoma duquesnei			X			
Moxostoma erythrurum			X		X	
Moxostoma macrolepidotum						
Hypentelium nigricians	X	X	X			X
Oncorhynchus mykiss				X		
Cyprinus carpio						
Pylodictis olivaris						
Ictalurus punctatus						
Ameiurus melas			X			
Ameiurus natalis					X	
Lepomis gulosus					X	
Lepomis microlophus						
Lepomis gibbosus						
Lepomis humilis	X	X		X		
Lepomis cyanellus	X		X	X	X	X
Lepomis macrochirus	X	X		X		X
Lepomis megalotis	X			X		X
Micropterus salmoides	X	X	X	X	X	X
Micropterus punctulatus	X					

Species	Indian Creek	Jenkins Creek	Jones Creek	Joyce Creek	Little North Fork	Lost Creek
Micropterus dolomieui			X			X
Pomoxis annularis	X	X	X			
Pomoxis nigromaculatus						
Ambloplites rupestris					X	X
Carassius auratus						
Opsopoeodus emiliae						
Campostoma anomalum	X		X		X	X
Pimephales promelas						
Pimephales tenellus						
Pimephales notatus	X			X		X

Species	Indian Creek	Jenkins Creek	Jones Creek	Joyce Creek	Little North Fork	Lost Creek
Lepomis microlophus						
Lepomis gibbosus						
Lepomis humilis			X		X	
Lepomis cyanellus			X		X	X
Lepomis macrochirus		X	X		X	X
Lepomis megalotis	X	X	X		X	X
Micropterus salmoides	X	X			X	X
Micropterus punctulatus	X				X	
Micropterus	X		X			X

Species	Indian Creek	Jenkins Creek	Jones Creek	Joyce Creek	Little North Fork	Lost Creek
dolomieui						
Pomoxis annularis						
Pomoxis nigromaculatus						
Ambloplites rupestris		X	X	X		
Carassius auratus						
Opsopoeodus emiliae						
Campostoma anomalum	X	X	X	X	X	X
Pimephales promelas						
Pimephales tenellus						
Pimephales notatus	X		X			X

Species	Dry Fork	Elm Branch	Elm Spring Branch	Glendale Fork	Hickory Creek	Honey Creek
Pimephales vigilax						
Luxilus cardinalis	X		X		X	X
Luxilus crysocephalus			X			
Cyprinella camura	X					
Cyprinella lutrensis				X		
Cyprinella spilotera						
Luthrurus umbratilis	X			X		
Semotilus atromaculatus					X	X
Notropis nubilus	X		X			X
Notropis boops	X					X

Species	Dry Fork	Elm Branch	Elm Spring Branch	Glendale Fork	Hickory Creek	Honey Creek
Notropis buchanani						
Notropis volucellus	X					
Notropis rubellus	X		X			X
Phoxinus erythrogaster			X		X	
Phenacobis morabilis						
Hybopsis amblops						
Hybopsis x punctatus						
Nocomis asper	X		X		X	X

Species	Indian Creek	Jenkins Creek	Jones Creek	Joyce Creek	Little North Fork	Lost Creek
Pimephales vigilax						
Luxilus cardinalis	X	X	X			X
Luxilus crysocephalus						
Cyprinella camura					X	X
Cyprinella lutrensis					X	
Cyprinella spilotera						
Luthrurus umbratilis			X		X	
Semotilus atromaculatus	X	X	X	X		X
Notropis nubilus	X	X	X			X
Notropis boops			X			
Notropis buchanani						
Notropis volucellus						
Notropis rubellus		X	X			X

Species	Indian Creek	Jenkins Creek	Jones Creek	Joyce Creek	Little North Fork	Lost Creek
Phoxinus erythrogaster		X	X	X		X
Phenacobis morabilis					X	
Hybopsis amblops			X			X
Hybopsis x punctatus						
Nocomis asper	X	X	X			X

Species	Dry Fork	Elm Branch	Elm Spring Branch	Glendale fork	Hickory Creek	Honey Creek
Notemigonus crysoleucas	X	X		X		
Fundulus olivaceus						
Fundulus notatus	X					X
Fundulus catenatus Fundulua sciadicus						
Gambusia affinis	X	X				
Labidesthes sicculus	X	X				
Cottus carolinae	X				X	X
Noturus exilis	X				X	X
Noturus miurus						
Noturus flavus						
Noturus placidus						
Noturus nocturnus						
Noturus gyrinus	X					
Percina caprodes	X					
Percina copelandi	X					
Percina phoxocephala						

Species	Dry Fork	Elm Branch	Elm Spring Branch	Glendale fork	Hickory Creek	Honey Creek
Etheostoma blennioides	X		X			X

Species	North Fork	Pettis Creek	Shoal Creek	Spring River	Stahl Creek	Truitt Creek
Lepisosteus platostomus						
Lepisosteus osseus	X			X		
Dorosoma cepedianum	X			X		
Ictiobus cyprinellus						
Ictiobus niger			X			
Carpiodes carpio				X		
Minytrema melanops	X	X	X	X		
Catostomus commersoni			X	X	X	X
Moxostoma carinatum	X			X		
Moxostoma duquesnei	X	X	X			
Moxostoma erythrurum	X		X	X		
Moxostoma macrolepidotum	X			X		
Hypentelium nigricians			X	X	X	X
Oncorhynchus mykiss				X		
Cyprinus carpio	X			X		
Pylodictis olivaris	X		X	X		
Ictalurus punctatus	X			X		
Ameiurus melas	X		X	X		X

Species	North Fork	Pettis Creek	Shoal Creek	Spring River	Stahl Creek	Truitt Creek
Ameiurus natalis	X	X				
Lepomis gulosus			X			

Species	Turkey Creek	T26 R32 S28*	T28 R33 S15*	T29 R33 S15*	White Oak Creek	West Fork	Lost Creek
Lepisosteus platostomus							
Lepisosteus osseus							
Dorosoma cepedianum							
Ictiobus cyprinellus						X	
Ictiobus niger							
Carpiodes carpio							
Minytrema melanops	X				X		
Catostomus commersoni	X	X			X		X
Moxostoma carinatum							
Moxostoma duquesnei	X				X		
Moxostoma erythrurum					X		
Moxostoma macrolepidotum							X
Hypentelium nigricians					X		
Oncorhynchus mykiss							
Cyprinus carpio						X	
Pylodictis olivaris							

Species	Turkey Creek	T26 R32 S28*	T28 R33 S15*	T29 R33 S15*	White Oak Creek	West Fork	Lost Creek
Ictalurus punctatus							
Ameiurus melas				X		X	
Ameiurus natalis							
Lepomis gulosus							

Species	North Fork	Pettis Creek	Shoal Creek	Spring River	Stahl Creek	Truitt Creek
Pimephales vigilax	X			X		
Luxilus cardinalis	X		X	X	X	X
Luxilus crysocephalus	X		X	X		X
Cyprinella camura	X		X	X		
Cyprinella lutrensis	X		X	X		
Cyprinella spilotera	X		X			
Luthrurus umbratilis	X			X		
Semotilus atromaculatus	X		X	X	X	X
Notropis nubilus			X	X	X	X
Notropis boops	X		X	X		X
Notropis buchanani	X			X		
Notropis volucellus	X			X		
Notropis rubellus	X		X	X	X	X
Phoxinus erythrogaster			X	X		X
Phenacobis morabilis	X			X		X
Hybopsis amblops			X	X		
Hybopsis x punctatus			X	X		

Species	North Fork	Pettis Creek	Shoal Creek	Spring River	Stahl Creek	Truitt Creek
Nocomis asper	X		X	X	X	X

Species	Turkey Creek	T26 R32 S28	T28 R33 S15	T29 R29 S15	White Oak Creek	West Fork	Williams Creek
Pimephales vigilax							
Luxilus cardinalis	X				X		X
Luxilus crysocephalus					X		X
Cyprinella camura	X						
Cyprinella lutrensis						X	
Cyprinella spilotera							
Luthrurus umbratilis	X			X	X	X	X
Semotilus atromaculatus	X	X			X		X
Notropis nubilus					X		X
Notropis boops	X				X		X
Notropis buchanani							
Notropis volucellus							
Notropis rubellus	X				X		X
Phoxinus erythrogaster		X	X		X		X
Phenacobis morabilis							
Hybopsis amblops							
Hybopsis x							

Species	Turkey Creek	T26 R32 S28	T28 R33 S15	T29 R29 S15	White Oak Creek	West Fork	Williams Creek
punctatus							
Nocomis asper					X		X

Species	North Fork	Pettis Creek	Shoal Creek	Spring River	Stahl Creek	Truitt Creek
Notemigonus crysoleucas	X	X		X		
Fundulus olivaceus			X			
Fundulus notatus	X		X	X		X
Fundulus catenatus						
Fundulua sciadicus				X		
Gambusia affinis	X	X	X	X		
Labidesthes sicculus	X		X	X		
Cottus carolinae			X	X	X	X
Noturus exilis	X		X	X	X	X
Noturus miurus	X			X		
Noturus flavus				X		
Noturus placidus				X		
Noturus nocturnus				X		
Noturus gyrinus						
Percina caprodes	X		X	X		
Percina copelandi	X		X	X		
Percina phoxocephala	X			X		
Etheostoma blennioides	X		X	X		

Species	Turkey reek	T26 R32 S28	T28 R33 S15	T29 R29 S15	White Oak Creek	West Fork	Williams Creek
Notemigonus				X		X	X

Species	Turkey reek	T26 R32 S28	T28 R33 S15	T29 R29 S15	White Oak Creek	West Fork	Williams Creek
crysoleucas							
Fundulus olivaceus							
Fundulus notatus							
Fundulus catenatus							
Fundulua sciadicus							
Gambusia affinis			X		X	X	X
Labidesthes sicculus	X				X		X
Cottus carolinae					X		X
Noturus exilis	X	X	X		X		
Noturus miurus							
Noturus flavus							
Noturus placidus							
Noturus nocturnus							
Noturus gyrinus							
Percina caprodes							
Percina copelandi							
Percina phoxocephala							
Etheostoma blennioides							

Species	North Fork	Pettis Creek	Shoal Creek	Spring River	Stahl Creek	Truitt Creek
Etheostoma punctulatum			X	X	X	X
Etheostoma nigrum	X			X		

Species	North Fork	Pettis Creek	Shoal Creek	Spring River	Stahl Creek	Truitt Creek
Etheostoma stigmaeum	X		X	X		
Etheostoma zonale	X		X	X		
Etheostoma flabellare	X		X	X	X	X
Etheostoma spectabile	X	X	X	X	X	X
Ehteostoma cragini	X		X	X		
Etheostoma whipplei	X			X		
Etheostoma gracile	X					
Etheostoma chlorosomum	X					
Etheostoma microperca		X	X			

Species	Turkey Creek	T19 R32 S28	T-28 R33 S15	T29 R 29 S15	White Oak Creek	West Fork	Williams Creek
Etheostoma punctulatum		X					X
Etheostoma nigrum					X		
Etheostoma stigmaeum							
Etheostoma zonale							
Etheostoma flabellare							
Etheostoma spectabile	X	X	X		X		X
Ehteostoma cragini		X	X				
Etheostoma whipplei							

Species	Turkey Creek	T19 R32 S28	T-28 R33 S15	T29 R 29 S15	White Oak Creek	West Fork	Williams Creek
Etheostoma gracile							
Etheostoma chlorosomum							
Etheostoma microperca							

- Pugnose minnow *Opsopoeodus emiliae*
- Bigeye chub *Hybopsis amblops*
- Freckled madtom *Noturus nocturnus*
- Tadpole madtom *Noturus gyrinus*
- Bluntnose darter *Etheostoma chlorosomum*

Inadequate sampling methods could explain the absence of all these species in collections made by District 9 staff and Beckman. The goldfish is usually introduced through bait or pet releases, so the absence of this species could be due to poor survival.

Bigmouth buffalo, river carpsucker, and the river redhorse are all large species. It is possible that they were not collected by Beckman and Fisheries District 9 staff because of net avoidance and inability to reach the deeper, preferred habitats of these fishes.

The pugnose minnow, freckled madtom, and bluntnose darter have not been collected by anyone in the basin since the 1940s. All of these species have very limited distributions in the basin and may therefore be lost to this region of the state.

The bigeye chub and tadpole madtom have not been collected since at least 1973. The tadpole madtom has a very limited distribution in the northern portion of the basin. The bigeye chub, however, does not have a limited distribution and may be absent from collections due to extirpation or sampling error.

Rare, Threatened, and Endangered Species

The Spring River Basin contains a unique and equally diverse flora and fauna that includes three federally endangered species; the gray bat *(Myotis grisescens),* running buffalo clover *(Trifolium stoloniferum),* and the American burying beetle *(Nicrophorus americanus).* There are several federally threatened species in the basin as well. Federally threatened species are: the Ozark cavefish *(Amblyopsis rosae),* the Neosho madtom *(Noturus placidus),* geocarpon *(Geocarpon minimum),* western prairie fringed orchid *(Platanthera praeclara),* and the Mead's milkweed, *(Asclepias meadii).*

State endangered species are:

- Northern harrier *Circus cyaneus*
- Ozark cavefish *Amblyopsis rosae*
- Redfin darter *Etheostoma whipplei*
- Neosho madtom *Noturus placidus*
- Black-tailed jack rabbit *Lepus californicus*
- Gray bat *Myotis grisescens*
- Plains spotted skunk *Spilogale putorius intemipta*
- Rabbits foot *Quadrula cylindrica cylindrica*
- Prairie false foxglove *Agalinis heterophylla*
- Green false foxglove *Agalinis viridis*
- Mead's milkweed *Asclepias meadii*
- Marsh bellflower *Campanula aparinoides*
- Lake-bank sedge *Carex lacustris*
- Alabama lip-fern *Chalanthes alabamensis*
- Joint grass *Coelorachis cylindrica*
- Tansy mustard *Descurainia pinnata*
- Geocarpon *Geocarpon minimum*
- A wild pea *Lathyrus pusillus*

- Pinnate dog shade *Limnosciadium pinnatum*
- *A lipocarpha Lipocarpha drummondii*
- Water hyssop *Mecardonia acuminata*
- Mudbank paspalum *Paspalum dissectum*
- Western prairie fringed orchid *Planthera praeclara*
- Slender pondweed *Potamogeton pusillus var pusillus*
- Kansas arrowhead *Sagittaria ambigua*
- Running buffalo clover *Trifolium stoloniferum*
- Yellow-eyed grass *Xyris torta*
- At least one species originally found in this basin is now extirpated from the drainage; the federally endangered American burying beetle.

Species that are considered rare or threatened in Missouri that inhabit the Spring River Basin are:

- Cooper's hawk *Accipiter cooperii*
- Henslow's sparrow *Ammodramus henslowii*
- Pied-billed grebe *Podilymbus podiceps*
- Greater prairie-chicken *Tympanuchus cupido*
- Barn owl *Tyto alba*
- Bluntface shiner *Cyprinella camura*
- Arkansas darter *Etheostoma cragini*
- Western slim minnow *Pimephales tenellus tenellus*
- Auriculate false foxglove *Agalinis auriculata*
- Tradescant aster *Aster dumosus var strictior*
- Oklahoma sedge *Carex oklahomensis*
- Small spike rush *Eleocharis parvula var anachaeta*
- A moss *Leska polycarpa*
- Low prickly pear *Opuntia macrorhiza*
- Ozark wake robin *Trillium pusillum var ozarkanum*
- A Venus' looking glass *Triodanis lamprosperma*
- Prairie mole cricket *Gryllotalpa major*
- Arkansas snaketail dragonfly *Ophiogomphus westfalli*
- Western fanshell *Cyprogenia aberti*
- Neosho mucket Lampsilis rafinesqueana
- Great plains skink *Eumeces obsoletus*
- Long-tailed weasel *Mustella frenata*
- Swamp rabbit *Sylvilagus aquaticus*

State watch list species in the Spring River Basin include:

- Northern crayfish frog *Rana areolata circulosa*
- Grotto salamander *Typhlotriton spelaeus*
- Upland sandpiper *Bartramia longicauda*
- Bristly cave crayfish *Cambarus setosus*
- Least darter *Etheostoma microperca*
- Ghost shiner *Notropis buchanani*
- Pugnose minnow *Opsopoeodus emiliae*
- Purple lilliput *Toxolasma lirudus*
- A false foxglove *Agalinis skinneriana*

- Sixteenweeks three-awn *Aristida adscensionis*
- Brush's poppy mallow *Callirhoe bushii*
- Yellow false mallow *Malvastrum*
- An adder's tongue fern *Ophioglossum vulgatum*
- Soapberry Sapindus drummondii
- Royal catchfly *Silene regia*
- Yellow-flowered leafcup *Smallanthus wedalius*
- Slender ladies' tresses *Spiranthes lacera var gracilis*
- Regal fritillary *Speyeria idalia*

There are several species of concern in the basin which have been studied extensively—the Neosho madtom, the Arkansas darter, the Neosho mucket (Figures 7A-F), and the Ozark cavefish.

The Neosho madtom is listed by the state as endangered and is federally threatened. Low densities may be characteristic of the species, but the population densities are the lowest in the Spring River portion of its range (Wilkinson and Edds 1996). Even considering low densities, one of the areas important to maintaining the population is the area from the North Fork of the Spring River to the Kansas border (Wilkinson and Edds 1996). There are several factors which pose a threat to this population. These include gravel removal, drought, chemical pollution, nutrient loading from feedlot runoff, and flow alterations (USFWS 1991). There is also a possibility that competition with the slender and brindled madtoms and stonecats may contribute to low numbers of the Neosho madtom.

Restoring artificial riffle habitat (Fuselier and Edds 1995) and maintaining base flow (USFWS 1991) would be beneficial strategies for maintaining or improving current Neosho madtom population densities.

Arkansas darters are typically found in small, springfed streams associated with beds of submerged aquatic plants (Pflieger 1992), most specifically watercress (Robison and Buchanan 1988). The habitat is characterized by shallow water and the absence of strong current (Pflieger 1992). In collections, it is commonly associated with stippled darters, orangethroat darters, and fantail darters. The collections made by Pflieger (1992) indicate that there has been no decline in abundance of this species in this portion of its range. Threats to the species include flow changes, water quality problems (Loeffler and Krieger 1994), urbanization, and livestock husbandry (Pflieger 1992).

Obermeyer et. al (1995) conducted a survey of the unionid species in southeast Kansas, including the Spring River. The authors found the Neosho mucket in shallow riffle and run habitats with gravel substrates in the Spring River. The youngest individual collected was four years old, and there was no evidence of reproduction. It is believed that the range reductions observed for this species are due to poor water quality of the Spring River downstream from the confluence of Turkey and Center creeks. It is also possible that channelization, gravel dredging, strip-mine runoff, feedlot runoff, isolation of downstream populations due to dams, and isolation from host fishes play key roles in the current distribution of this species.

The Ozark cavefish has been listed as a state endangered and federally threatened species. It is restricted to the southwest Ozarks in Missouri and Arkansas (Pflieger 1975). Approximate locations of the Ozark cavefish sites are shown in Figure 8.

Angler Survey Data

No on-site creel data have been collected from streams or reservoirs within the Missouri portion of the basin. Statewide angler survey data are available through MDC.

Commercial Fish Harvest

No recent commercial fish harvest has occurred within the Missouri portion of the basin.

Fish Introductions

Documented stockings of streams are limited. A number of authorized resource agency fish introductions have occurred in the streams in the Missouri portion of the basin. This includes the stocking of various salmonids. The earliest recorded release of salmonids was the introduction of "California salmon" to "Arkansas River tributaries" in Missouri (Turner 1979). As early as 1879, brook trout were stocked in the Spring River. The first recorded stocking of rainbow trout in Capps Creek occurred in 1886. Shoal Creek, Center Creek, Turkey Creek, Hickory Creek, and others received intermittent stocking of salmonids throughout the late 1800s and early 1900s. The spread of the common carp was probably hastened by purposeful stocking of area streams in the latter half of the last century.

Capps Creek near Jolly Mill is presently stocked with both rainbow and brown trout. Rainbow trout from the Neosho National Fish Hatchery are found in nearby Hickory Creek. A self-sustaining wild rainbow trout population has been documented in the Spring River. Limited natural reproduction has been documented in Spring River and Hickory Creek. Other wild, self-sustaining populations may exist.

Numerous ponds and small reservoirs throughout the basin have been stocked with a variety fish including largemouth bass, bluegill, grass carp, flathead catfish, and channel catfish. Escapement of stocked fish from impoundments probably occurs, but the extent is undocumented.

Fishing Regulations

Statewide fishing regulations (daily limits, size limits, methods, and seasons) apply to streams throughout the Spring River Basin. Please refer to the most recent version of the Wildlife Code of Missouri and signs posted at public accesses for specific regulations.

Aquatic Invertebrates

Dieffenbach and Ryck (1976) assessed the effects of pollutants on stream water quality using the density, diversity, and composition of bottom-dwelling invertebrates as a reflection of water quality at several sites throughout the basin. They concluded that the upper Spring River, the lower Spring River, the North Fork of the Spring River, Turkey Creek, and lower Center Creek had invertebrate communities indicative of polluted streams. The diversity indices were especially low in Turkey Creek, which had only nine invertebrate taxa recorded. The lower Spring River (near the Kansas border) area community structure was different and could perhaps be due to a difference in habitat types (more of a prairie stream than an Ozark stream) rather than extreme pollution problems. The upper Center Creek and Shoal Creek areas had invertebrate communities similar to unpolluted streams, suggesting that water quality was good in these areas. Sewage effluent and industrial discharge were the authors' explanation for the poor invertebrate communities.

To our knowledge no recent studies have been conducted on the invertebrate communities of the region to determine present water quality. Table 25 lists the invertebrates collected throughout the basin.

Management Problems and Opportunities

These management goals, objectives, and strategies were developed to address objectives in the Missouri Department of Conservation's Strategic Plan, Fisheries Division's Strategic Plan, the Stream Areas Program Strategic Plan, and the Stream Acquisition Plan. These plans address strategic areas of future resource management, public awareness, and access needs.

Goal I: Improve water quality and maintain or improve water quantity in the Spring River Basin so all streams are capable of supporting native aquatic communities.

Status: Both point and nonpoint source pollution are threats to water quality in the basin. Human population is expanding in portions of the basin, particularly in the Joplin-Neosho-Carthage area. This population increase has resulted in increasing urbanization. Large poultry operations are common in the

basin along with related land application of poultry wastes. Like much of southwest Missouri, large farming corporations have shown interest in establishing operations within the basin that have the potential to increase and concentrate livestock waste runoff.

Objective 1.1: Streams within the basin will meet state standards for water quality.

Strategy: Enforcement of existing water quality regulations and necessary revisions to these regulations will help reduce violations. Water quality problems must also be addressed through aggressive public awareness efforts and by encouraging good land use in riparian areas and throughout watersheds in the basin. Citizen activism is alive and well in the basin through STREAM TEAMs, and this should be encouraged. Working with related agencies to promote public awareness and incentive programs, cooperating with citizen groups involved with water quality issues in the basin, and helping to enforce water quality laws will be among the most efficient ways to achieve this objective.

- Enhance people's awareness of 1) water quality problems (i.e., point source pollution, animal waste runoff, etc.) affecting aquatic biota, 2) viable solutions to these problems, and 3) their role in implementing these solutions. Media contacts, personal contacts, special events, and literature development and distribution will be used to reach people throughout the basin.
- Review NPDES, Section 404, and other permits and either recommend denial or appropriate mitigation for those which are harmful to aquatic resources. Related activities will include cooperating with other state and federal agencies to investigate pollution events and fish kills, assisting with the enforcement of existing water quality laws, and recommending appropriate measures to protect and enhance aquatic communities.
- Work with the Missouri Department of Health and MDNR to reduce contaminant levels in fish by collecting fish for contaminant analysis, advising the fishing public on the impacts of contaminant levels, and identifying and eliminating sources of contamination.
- Work with MDNR to monitor water quality, improve water quality, and ensure compliance with discharge permits. With training, volunteer groups, such as STREAM TEAMs, could assist with water quality monitoring and improvement. These volunteer groups are strong advocates for good water quality throughout the basin. Further development of STREAM TEAMs should be encouraged. Related monitoring efforts should also be encouraged and directed to strategic locations.
- Serve in an advisory role to citizen organizations and local governments on water resource issues. These efforts will help to ensure that existing and potential impacts to aquatic biota are recognized by the general public, community leaders, and local agencies and that efforts to minimize these impacts are included in local planning documents, regulations, and statutes.

Objective 1.2: Maintain base flows in streams within the basin at or above current levels within the constraints imposed by natural seasonal variations and precipitation.

Strategy: The most efficient and effective way to address these concerns will be through existing agency programs and the legislative process.

- Summarize existing data and, working with USGS, gather available flow information to create flow duration curves for streams within the basin. Using these and other appropriate data, establish flow regimes that protect or enhance fish and other aquatic life.
- Working with MDNR and the U.S. Army Corps of Engineers (COE), protect or enhance stream flows through oversight and enforcement of existing water withdrawal permits and other related permits.
- Support development of water law and an interstate compact/agreement that will address the quantity of water in Missouri's streams.

- Increase public awareness of and concern for water quantity problems, the affected aquatic biota, and potential solutions through media contacts, personal contacts, and literature development and distribution.

Goal II: Improve riparian and aquatic habitat conditions in the Spring River Basin to meet the needs of native aquatic species while accommodating demands for water and agricultural production.

Status: Stream habitat quality is fair to good throughout most of the basin. Some areas, including portions of the Capps Creek sub-basin, suffer from a more severe lack of riparian vegetation. The lack of adequate riparian corridors, excessive nutrient loading, drainage from mine tailings, streambank erosion, excessive runoff and erosion, and the effects of instream activities such as gravel mining are among the problems observed. Grazing practices along many streams contribute to streambank instability, nutrient loading, and poor riparian corridor conditions. Increased clearing and higher runoff associated with urbanization also impact stream habitat quality.

Objective 2.1: Riparian landowners on third order and larger streams will understand the importance of good stream stewardship and where to obtain technical assistance for sound stream habitat improvement.

- **Strategy:** Advertising and promoting stream programs, installing and maintaining demonstration projects, and providing educational opportunities to landowners will make them more aware of the reasons and techniques for protecting streams. Emphasizing economic aspects of stream improvement will encourage more landowners to participate.
- Work with MDC's Outreach and Education Division staff to develop stream management related materials and present related courses for elementary and secondary school teachers.
- Establish and maintain stream management demonstration sites. Initially, an existing site on Dry Fork Creek will be used for demonstration purposes. Thereafter, additional sites will be developed on MDC frontage, the Community Assistance Program (CAP) project on Hickory Creek in Neosho, and as part of an anticipated SALT project in the Capps Creek watershed. Other sites will be located to provide demonstration opportunities to landowners throughout the basin.
- Promote good stream stewardship through landowner workshops and stream demonstration site tours.

Objective 2.2: Maintain, expand, and restore riparian corridors; enhance watershed management; improve instream habitat; and reduce streambank erosion throughout the basin.

Strategy: High quality aquatic habitat is the critical factor in maintaining and improving natural stream communities. Stream habitat conditions will be improved by cooperating with and providing technical assistance to private landowners, working with other local, state, and federal agencies to manage stream frontages on their properties, and installing stream improvement and habitat enhancement projects on MDC lands within the basin. Monitoring habitat conditions and using regulatory avenues to reduce impacts from development projects should also help to identify problems and minimize impacts on the stream resource.

- Monitor habitat conditions in the basin periodically by using SHAD (or similar methodologies), aerial photography, and helicopter reconnaissance. Map riparian corridors on selected third order and all fourth order and larger streams. Prepare GIS layers when the technology is available, and update as needed.
- Ensure that all MDC areas are examples of good stream and watershed management by including appropriate recommendations and prescriptions in area plans, implementing these practices in a timely manner, and monitoring these practices throughout their life. These practices will include,

but may not be limited to, riparian corridor re-establishment, riparian corridor management, and maintaining soil erosion levels at "T" (soil replacement level) or lower.

- Provide technical recommendations to all landowners that request assistance.
- Improve riparian corridor and watershed conditions by actively participating in SALT projects that incorporate fish and wildlife values and promote sound stream stewardship. Cooperate with NRCS and the City of Neosho on the watershed management (PL566) project on Hickory Creek, NRCS and the Barry County SWCD on the SALT/AgNPS project on upper Shoal Creek, and with NRCS and SWCD boards to establish a SALT project in the Capps Creek watershed and in additional watersheds as appropriate.
- Improve landowner stewardship of streams by promoting and implementing cost share programs, including MDC's watershed-based programs, that include streambank stabilization, alternative watering provisions, and establishment and maintenance of quality riparian corridors.

Objective 2.3: Critical and unique aquatic habitats will be identified and protected from degradation.

Strategy: Identification, acquisition, targeted private landowner programs, and cooperation with other agencies/organizations will result in better management of critical and unique aquatic areas.

- Conduct additional fish population sampling to further define and delineate unique and critical habitats.
- Collect additional background information from the public and resource professionals to better define critical and unique aquatic habitats.
- Acquire critical and unique aquatic habitats. Priority areas will include frontage along Capps Creek, Ozark cavefish cave sites and their recharge areas, and springs and sinkholes.

Goal III: Maintain diverse and abundant populations of native aquatic organisms while accommodating angler demands for quality for quality fishing.

Status: The basin has a diverse fish assemblage comprised of 86 fish species collected since the 1930s. Spring River, North Fork of the Spring River, Center Creek, and Shoal Creek have the most diverse fish communities. Capps Creek, in Newton County, is managed as a coldwater fishery. Additional efforts to enhance the coldwater fishery on Hickory Creek near Neosho are under consideration.

- The Ozark cavefish is found in selected cave systems in the basin. The Ozark cavefish and Neosho madtom are listed as endangered by MDC and threatened by the U.S. Fish and Wildlife Service. The Ozark cavefish and Neosho madtom are the only federally listed threatened fish species in the basin. The redfin darter is also listed as endangered by MDC. State listed rare, threatened, or watch listed fish species found in the basin are the least darter, bluntface shiner, western slim minnow, ghost shiner, and pugnose minnow.
- Self-sustaining populations of introduced rainbow trout are found in the upper portion of Spring River and Hickory Creek near Neosho. A coldwater fishery is supported by stocking rainbow and brown trout in Capps Creek. Sufficient samples to assess the status of most sportfish populations are lacking.
- Black bass (smallmouth, largemouth, and spotted bass), brown and rainbow trout, and rock bass are actively managed for sportfishing.
- Sportfish sampling has been conducted on portions of the Spring River and Shoal Creek to assess the potential and need for special black bass management regulations. No regulation changes are currently planned for the Spring River. Additional data analysis is pending for Shoal Creek.
- Some invertebrate sampling has been conducted in the basin, but a system-wide comprehensive invertebrate collection has not been made.

Objective 3.1: Evaluate and maintain sportfish populations, with primary emphasis on black bass and rainbow trout, at sufficient quality and condition to satisfy the angling public.

Strategy: Assess the quality of sportfish populations and take steps to improve their populations through public education, regulations, habitat improvement, stocking, and other methods.

- Develop and implement a monitoring program to obtain trend data on sportfish populations in the Spring River and its major tributaries.
- Identify critical habitat areas for actively managed sportfish species and maintain or enhance these areas as needed to improve habitat.
- Using regulations, habitat improvement, and other methods, continue implementation of population improvement programs for actively managed sportfish species.
- Conduct a survey of anglers to determine catch, harvest, species preference, and fishing pressure.
- Increase angler awareness of the recreational potential of fishes other than black bass and rainbow trout, such as catfish, buffalo, carp, drum, and gar.

Objective 3.2: Maintain populations of native non-game fishes, including the Ozark cavefish, Neosho madtom, and Arkansas darter, and aquatic invertebrates at or above present levels throughout the basin.

Strategy: Assess the status of fish and invertebrate communities throughout the basin. Techniques to maintain or improve non-game fishes will depend on the fish communities in decline and the causative agent. It is also assumed that improvements in other aquatic life will occur simultaneous to those occurring in fish communities.

- Develop standard sampling techniques for assessing fish and invertebrate communities, including the use of indicator species, and implement a monitoring program to track trends in species diversity and abundance.
- Maintain or enhance aquatic biodiversity and protect or enhance fish species diversity and abundance using regulations, stocking, habitat improvement, and related techniques,
- Strategy: In cooperation with MDC's Natural History Section, continue efforts to assess the status of Ozark cavefish, Neosho madtom, and Arkansas darter populations throughout the basin and implement the existing federal recovery plans for the Neosho madtom and Ozark cavefish.
- Continue monitoring efforts at known and historic Ozark cavefish sites and follow-up on new reports of possible cavefish populations.
- Monitor populations of the Neosho madtom and the Arkansas darter as a part of standard fish community sampling throughout the basin.
- Continue public awareness and habitat management efforts related to Ozark cavefish and consider additional possibilities for non-MDC funding for additional inventory work, continued public awareness efforts, and habitat management efforts.
- Protect and improve Ozark cavefish habitat by implementing MDC cost share programs and encouraging stream, spring, and cave related cost share practices to be included on SWCD dockets (e.g., livestock fencing, abandoned well capping, alternative water sources, etc.).
- Protect and improve stream habitats that support populations of the Neosho madtom and Arkansas darter by implementing MDC cost share programs and encouraging stream and spring cost share practices to be included on SWCD dockets (e.g., livestock fencing, riparian corridor enhancement, alternative water sources, etc.).
- Participate in recovery efforts including interstate conferences and recovery team meetings.

Goal IV: Improve the public's appreciation for stream resources and increase recreational use of streams in the Spring River Basin.

Status: Streams in the basin are used extensively for both fishing and other recreational activities. The Spring River, Center Creek, and Shoal Creek each receive considerable use by floaters and canoeists. Thirteen public stream access sites are located in the basin. This includes a CAP site under development on Hickory Creek in Neosho and stream frontage on Capps Creek CA and Talbot CA.

- The public's understanding of the importance of streams culturally, biologically, and historically needs improving. While landowner participation in Streams For The Future programs has been limited, participation in the STREAM TEAM program has been good. Efforts are underway by several groups in the basin, including STREAM TEAMs, to improve public awareness of the importance of high quality streams.
- Objective 4.1: Access sites, bank fishing areas, and trails will be developed and maintained in sufficient numbers to accommodate public use.
- Strategy: We anticipate an increase in stream use because of an overall increase in the levels of fishing and other stream-based recreational activities. Acquisition and development projects along streams should be sufficient to meet these increasing demands.
- Conduct a recreational use survey within the basin in conjunction with an angler survey to determine existing levels of use and satisfaction with recreational opportunities in the basin.
- Acquire and develop public access and frontage sites (for boating and bank fishing) at strategic points, based on the Stream Areas Program Strategic Plan (McPherson 1994).
- Improve bank fishing and other aquatic wildlife-based recreational opportunities on public lands.

Objective 4.2: Increase the general public's awareness of stream recreational opportunities, local stream resources, and good watershed and stream management practices.

Strategy: The public will be made aware of stream related recreational opportunities and issues through media outlets, fair exhibits, and Missouri Conservationist articles.

- Increased appreciation of stream resources should follow enhanced public awareness and education. More concern about the quality and quantity of water within the basin's streams should follow, and greater citizen involvement and advocacy in related environmental issues should result. Newspaper articles, presentations, and special events highlighting streams should help foster this awareness.
- Working with MDC's Outreach and Education Division staff, use streams in aquatic education programs. Identify and develop stream locations appropriate for educational field trips near participating schools.
- Maintain a stream emphasis at public events such as the Ozark Empire Fair, Springfield Boat Show, etc.
- Assist in the development of one article for the Missouri Conservationist and make suggestions for a future MDC video ("Missouri Outdoors", etc.) to highlight Spring River Basin recreational opportunities.
- Contribute to future revisions of Missouri Ozark Waterways.
- Prepare an annual fishing prospectus for selected streams.
- Promote the formation of STREAM TEAMs and STREAM TEAM associations within the basin.
- Distribute information through STREAM TEAMs and related organizations.

Angler Guide

Unlike many stream basins, there are no large reservoirs in the Missouri portion of the Spring River Basin. However, anglers can enjoy fishing for largemouth bass, bluegill and channel catfish in several small lakes and ponds located on three Missouri Department of Conservation areas within the basin (Robert E. Talbot Conservation Area (CA), Shawnee Trail CA and Dorris Creek Prairie). Two community lakes managed by the Missouri Department of Conservation are also open to public fishing.

The basins stream fishery is diverse and provides the majority of the fishing opportunities in the Spring River Basin. Rainbow trout populations exist in the headwaters of the Spring River and Center Creek. These populations are self-sustaining. Both rainbow trout and brown trout are present in the Capps Creek Trout Management Area and are maintained by frequent stockings. Public access to Capps Creek is available, but stream frontage along the coldwater reaches of Spring River and Center Creek is largely in private ownership.

All three species of black bass are present in the major tributary streams within the basin. Generally, smallmouth bass are more prevalent in the upstream reaches, while spotted bass are more prominent in downstream reaches. Largemouth bass are present throughout most stream reaches. Anglers can usually target a particular bass species by fishing specific habitats. Fishing fast, deep water around large boulders is likely to produce smallmouth bass. Largemouth bass are usually found around woody cover in the slow, deep pools and in backwater areas. Plastic grubs, crayfish and minnow imitations, along with crankbaits and buzz baits, are good choices to use for catching black bass. Public access and good black bass fishing opportunities are available on Shoal Creek, Center Creek and the Spring River. Jones and Jenkins creeks are tributaries to Center Creek and offer good wade fishing, especially for smallmouth bass.

Excellent rock bass (goggle-eye) angling can be found in Shoal Creek. Center Creek and Spring River also contain rock bass in good numbers. Anglers using small crayfish baits and plastic grubs can usually catch some rock bass. Longear, bluegill and green sunfish are other sunfish species that anglers will frequently encounter on streams within the Spring River Basin.

Limb lines and trotlines are popular fishing methods employed to catch catfish in the downstream reaches of the Spring River and the North Fork of the Spring River. These areas have reduced water clarity and provide ideal habitat for catfish. Numbers and sizes of channel catfish in these population are very good.

Many of the streams in the Spring River Basin also have abundant populations of large suckers, but low visibility usually prevents successful gigging trips until late in the season.

Glossary

Alluvial soil: Soil deposits resulting directly or indirectly from the sediment transport of streams, deposited in river beds, flood plains, and lakes.

Aquifer: An underground layer of porous, water-bearing rock, gravel, or sand.

Benthic: Bottom-dwelling; describes organisms which reside in or on any substrate.

Benthic macroinvertebrate: Bottom-dwelling (benthic) animals without backbones (invertebrate) that are visible with the naked eye (macro).

Biota: The animal and plant life of a region.

Biocriteria monitoring: The use of organisms to assess or monitor environmental conditions.

Channelization: The mechanical alteration of a stream which includes straightening or dredging of the existing channel, or creating a new channel to which the stream is diverted.

Concentrated animal feeding operation (CAFO): Large livestock (ie. cattle, chickens, turkeys, or hogs) production facilities that are considered a point source pollution, larger operations are regulated by the MDNR. Most CAFOs confine animals in large enclosed buildings, or feedlots and store liquid waste in closed lagoons or pits, or store dry manure in sheds. In many cases manure, both wet and dry, is broadcast overland.

Confining rock layer: A geologic layer through which water cannot easily move.

Chert: Hard sedimentary rock composed of microcrystalline quartz, usually light in color, common in the Springfield Plateau in gravel deposits. Resistance to chemical decay enables it to survive rough treatment from streams and other erosive forces.

Cubic feet per second (cfs): A measure of the amount of water (cubic feet) traveling past a known point for a given amount of time (one second), used to determine discharge.

Discharge: Volume of water flowing in a given stream at a given place and within a given period of time, usually expressed as cubic feet per second.

Disjunct: Separated or disjoined populations of organisms. Populations are said to be disjunct when they are geographically isolated from their main range.

Dissolved oxygen: The concentration of oxygen dissolved in water, expressed in milligrams per liter or as percent.

Dolomite: A magnesium rich, carbonate, sedimentary rock consisting mainly (more than 50% by weight) of the mineral dolomite ($CaMg(CO_3)_2$).

Endangered: In danger of becoming extinct.

Endemic: Found only in, or limited to, a particular geographic region or locality.

Environmental Protection Agency (EPA): A Federal organization, housed under the Executive branch, charged with protecting human health and safeguarding the natural environment — air, water, and land — upon which life depends.

Epilimnion: The upper layer of water in a lake that is characterized by a temperature gradient of less than 1^{o} Celsius per meter of depth.

Eutrophication: The nutrient (nitrogen and phosphorus) enrichment of an aquatic ecosystem that promotes biological productivity.

Extirpated: Exterminated on a local basis, political or geographic portion of the range.

Faunal: The animals of a specified region or time.

Fecal coliform: A type of bacterium occurring in the guts of mammals. The degree of its presence in a

lake or stream is used as an index of contamination from human or livestock waste.

Flow duration curve: A graphic representation of the number of times given quantities of flow are equaled or exceeded during a certain period of record.

Fragipans: A natural subsurface soil horizon seemingly cemented when dry, but when moist showing moderate to weak brittleness, usually low in organic matter, and very slow to permeate water.

Gage stations: The site on a stream or lake where hydrologic data is collected.

Gradient plots: A graph representing the gradient of a specified reach of stream. Elevation is represented on the Y-axis and length of channel is represented on the X- axis.

Hydropeaking: Rapid and frequent fluctuations in flow resulting from power generation by a hydroelectric dam's need to meet peak electrical demands.

Hydrologic unit (HUC): A subdivision of watersheds, generally 40, 000-50, 000 acres or less, created by the USGS. Hydrologic units do not represent true subwatersheds.

Hypolimnion: The region of a body of water that extends from the thermocline to the bottom and is essentially removed from major surface influences during periods of thermal stratification.

Incised: Deep, well defined channel with narrow width to depth ration, and limited or no lateral movement. Often newly formed, and as a result of rapid down-cutting in the substrate

Intermittent stream: One that has intervals of flow interspersed with intervals of no flow. A stream that ceases to flow for a time.

Karst topography: An area of limestone formations marked by sinkholes, caves, springs, and underground streams.

Loess: Loamy soils deposited by wind, often quite erodible.

Low flow: The lowest discharge recorded over a specified period of time.

Missouri Department of Conservation (MDC): Missouri agency charged with: protecting and managing the fish, forest, and wildlife resources of the state; serving the public and facilitating their participation in resource management activities; and providing opportunity for all citizens to use, enjoy, and learn about fish, forest, and wildlife resources.

Missouri Department of Natural Resources (MDNR): Missouri agency charged with preserving and protecting the state's natural, cultural, and energy resources and inspiring their enjoyment and responsible use for present and future generations.

Mean monthly flow: Arithmetic mean of the individual daily mean discharge of a stream for the given month.

Mean sea level (MSL): A measure of the surface of the Earth, usually represented in feet above mean sea level. MSL for conservation pool at Pomme de Terre Lake is 839 ft. MSL and Truman Lake conservation pool is 706 ft. MSL.

Necktonic: Organisms that live in the open water areas (mid and upper) of waterbodies and streams.

Non-point source: Source of pollution in which wastes are not released at a specific, identifiable point, but from numerous points that are spread out and difficult to identify and control, as compared to point sources.

National Pollution Discharge Elimination System (NPDES): Permits required under The Federal Clean Water Act authorizing point source discharges into waters of the United States in an effort to protect public health and the nation's waters.

Nutrification: Increased inputs, viewed as a pollutant, such as phosphorous or nitrogen, that fuel abnormally high organic growth in aquatic systems.

Optimal flow: Flow regime designed to maximize fishery potential.

Perennial streams: Streams fed continuously by a shallow water table an flowing year-round.

pH: Numeric value that describes the intensity of the acid or basic (alkaline) conditions of a solution. The pH scale is from 0 to 14, with the neutral point at 7.0. Values lower than 7 indicate the presence of acids and greater than 7.0 the presence of alkalis (bases).

Point source: Source of pollution that involves discharge of wastes from an identifiable point, such as a smokestack or sewage treatment plant.

Recurrence interval: The inverse probability that a certain flow will occur. It represents a mean time interval based on the distribution of flows over a period of record. A 2-year recurrence interval means that the flow event is expected, on average, once every two years.

Residuum: Unconsolidated and partially weathered mineral materials accumulated by disintegration of consolidated rock in place.

Riparian: Pertaining to, situated, or dwelling on the margin of a river or other body of water.

Riparian corridor: The parcel of land that includes the channel and an adjoining strip of the floodplain, generally considered to be 100 feet on each side of the channel.

7-day $Q^{10:}$: Lowest 7-day flow that occurs an average of every ten years.

7-day Q^{2}: Lowest 7-day flow that occurs an average of every two years.

Solum: The upper and most weathered portion of the soil profile.

Special Area Land Treatment project (SALT): Small, state funded watershed programs overseen by MDNR and administered by local Soil and Water Conservation Districts. Salt projects are implemented in an attempt to slow or stop soil erosion.

Stream Habitat Annotation Device (SHAD): Qualitative method of describing stream corridor and instream habitat using a set of selected parameters and descriptors.

Stream gradient: The change of a stream in vertical elevation per unit of horizontal distance.

Stream order: A hierarchical ordering of streams based on the degree of branching. A first order stream is an unbranched or unforked stream. Two first order streams flow together to make a second order stream; two second order streams combine to make a third order stream. Stream order is often determined from 7.5 minute topographic maps.

Substrate: The mineral and/or organic material forming the bottom of a waterway or waterbody.

Thermocline: The plane or surface of maximum rate of decrease of temperature with respect to depth in a waterbody.

Threatened: A species likely to become endangered within the foreseeable future if certain conditions continue to deteriorate.

United States Army Corps of Engineers (USCOE) and now (USACE): Federal agency under control of the Army, responsible for certain regulation of water courses, some dams, wetlands, and flood control projects.

United States Geological Survey (USGS): Federal agency charged with providing reliable information to: describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect the quality of life.

Watershed: The total land area that water runs over or under when draining to a stream, river, pond, or lake.

Waste water treatment facility (WWTF): Facilities that store and process municipal sewage, before release. These facilities are under the regulation of the Missouri Department of Natural Resources.

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